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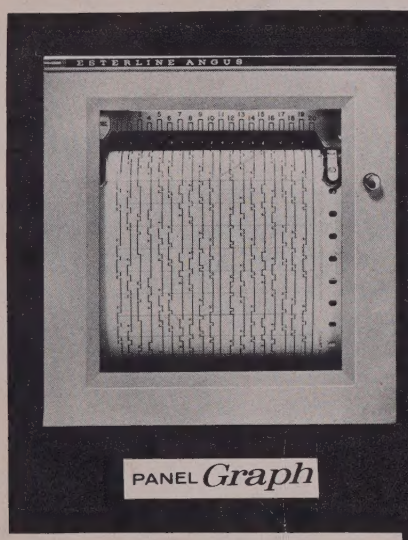
Electronic Services - Los Angeles
M12323X

INSTRUCTION MANUAL

SERIES "S"

EVENT RECORDERS



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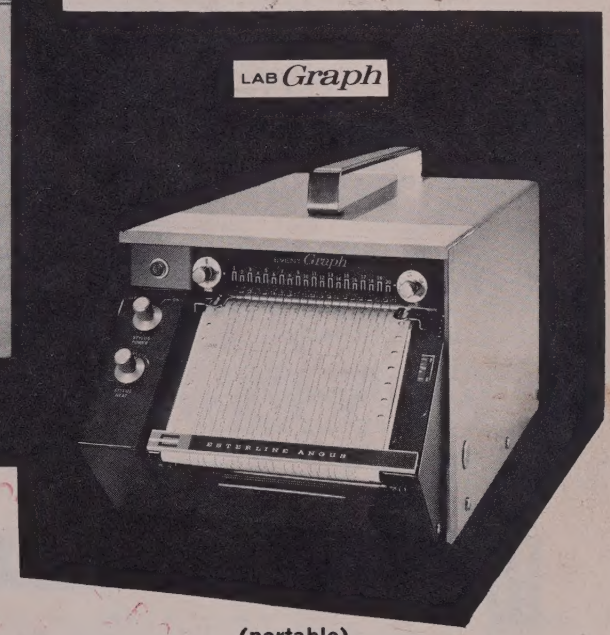

(portable)

FOR A COMPLETE TECHNICAL DESCRIPTION OF YOUR SPECIFIC INSTRUMENT, SEE THE DATA SHEET WHICH IS SUPPLIED WITH THIS MANUAL. SPECIAL DRAWINGS AND SUPPLEMENTARY INSTRUCTIONS THAT MAY BE REQUIRED FOR YOUR RECORDER WILL BE LISTED ON THE DATA SHEET AND WILL BE FOUND IN THE APPENDIX OF THIS MANUAL.

ESTERLINE ANGUS

A UNIT OF ESTERLINE CORPORATION

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SECTION A – INSTALLATION INSTRUCTIONS

INTRODUCTION

These instructions cover the Esterline Angus Series "S" LabGRAPH and PanelGRAPH Event Recorders. The LabGRAPH version is a bench-top recorder, whereas the PanelGRAPH is designed for permanent, flush installation in racks, switchboards or panels. The numerous options available for the LabGRAPH and PanelGRAPH event instruments include two graphic recording methods (ink-pen Model S620X and inkless, heated-stylus Model S620T), as well as a wide variety of synchronous chart drives. For a complete description of the particular instrument ordered, refer to the Data Sheet furnished with this manual.

UNPACKING

A packing slip listing all enclosed items is included with each shipment. Check off the items as they are unpacked; if anything is missing, go through the packing material carefully before throwing it away. After removing the instrument from its packing case, inspect each assembly for physical damage. If the shipment has been damaged in transit, notify both the carrier and Esterline Angus at once.

Remove shipping materials from the case, unpack all accessories, and remove hardware securing the chassis to its packing board.

> CAUTION: Do not attempt to operate a damaged instrument.

CASE INSTALLATION

The instrument should be mounted upright, level, and in a clean well-lighted location. The area should be free of dust, steam, moisture, smoke or corrosive fumes. The recorder should not be subjected to extremes of temperature. In addition, it should not be mounted close to transformers or conductors carrying high currents.

> CAUTION: Ambient operating temperatures must not exceed 120°F. Do not restrict air circulation in and around the recorder.

The LabGRAPH recorder, housed in a portable metal case, does not require physical installation. Electrical chart-drive power is conducted through a heavy-duty detachable cord supplied with the instrument; if an earth-ground power source is not available, it is recommended that a separate ground connection be made to the recorder case. Connections for event input must be made to the rear of the recorder as explained elsewhere in this section.

INSTALLATION

THE OVERALL DEPTH OF THE PANELGRAPH CASE IS 17-1/4" FROM ITS FRONT MOUNTING FLANGE; SPACE BEHIND THE MOUNTING PANEL MUST THEREFORE BE SUFFICIENT TO ACCOMMODATE THIS DIMENSION -- PLUS ADDITIONAL WIRING SPACE WHEN NEEDED. FOR INSTALLATIONS OTHER THAN IN RACKS WITH REMOVABLE PANELS, CLEARANCE MUST BE AVAILABLE ABOVE AND BELOW THE CASE TO FACILITATE MOUNTING PROCEDURES. WITHOUT FORCED-AIR COOLING, SPACE MUST ALSO BE PROVIDED ON ALL SIDES OF THE CASE TO MAINTAIN ADEQUATE AIR CIRCULATION.

THE "L" TYPE MOUNTING BRACKETS SUPPLIED WITH THE INSTRUMENT ARE SUITABLE FOR USE ON PANEL THICKNESSES OF 1/8" TO 1/4" (SPECIAL BRACKETS ARE ALSO AVAILABLE). IF THE PANELING MATERIAL IS THIN AND OF A LARGE AREA, ADDITIONAL SUPPORTS MAY BE NECESSARY.

PANEL CUTOUT REQUIREMENTS ARE 7-3/8" IN HEIGHT AND 7-11/16" IN WIDTH. ADDITIONAL MOUNTING HOLES OR SLOTS ARE NOT REQUIRED. SEE THE MOUNTING DIMENSIONAL DIAGRAM IN FIG. A1.

NOTE: BEFORE INSTALLING THE INSTRUMENT, MAKE CERTAIN THAT ALL ITEMS ARE UNPACKED AND THAT ALL SHIPPING MATERIALS ARE REMOVED.

MOUNTING PROCEDURES (PanelGraph)

1) EXAMINE CASE TO SEE THAT ALL COMPONENTS ARE IN OPERATING ORDER. DO NOT INSTALL CHASSIS UNTIL CASE IS MOUNTED.

   (A) CHECK DOOR LATCH AND HINGE ACTION. THE LATCH IS AN ADJUSTABLE PAWL TYPE.

   (B) SEE THAT RETRACTABLE CONNECTOR ASSEMBLY SLIDES IN AND OUT FREELY.

   (C) REMOVE BACKPLATE AND INSPECT CONNECTION PROVISIONS. IF CONDUIT CONNECTIONS ARE REQUIRED, REMOVE KNOCKOUTS FROM SIDE OF CASE. SHOULD CONNECTION MODIFICATIONS BE NECESSARY, PERFORM THIS OPERATION BEFORE INSTALLING THE CASE.

2) INSERT CASE THROUGH FRONT-PANEL CUTOUT WITH CASE DOOR HINGING TO THE LEFT. HOLD CASE SO THAT FLANGE IS FLUSH WITH FRONT OF PANEL.

3) PLACE ONE "L" BRACKET IN POSITION AGAINST INSIDE OF PANEL AT BOTTOM OF CASE. SEE THAT SLOTS IN BRACKET LINE-UP WITH SCREW HOLES IN BOTTOM OF CASE.

4) INSERT TWO MOUNTING SCREWS THROUGH THE BRACKET SLOTS AND TIGHTEN INTO CASE HOLES.

5) After screws are finger tight, force "L" bracket to one side so that it presses firmly against inside of panel. Tighten the screws securely with a screw-driver.

6) Mount the other "L" bracket to top of case by following the same procedures given in steps 3, 4, and 5.

7) If panel is of the removable type, it may now be fixed in its permanent position with the case attached.

If the instrument will be subjected to vibration or shock, it is recommended that an additional support bracket be installed at the rear of the case. As a safety precaution, it is recommended that the recorder case be grounded, unless otherwise specified. If the case is mounted on an insulated panel, connection should be made from the metal case to a convenient ground bus.

CHASSIS INSTALLATION (PanelGraph)

The recorder chassis for a PanelGraph instrument incorporates three major sections: The chart transport assembly, which is found at the front of the chassis; the graphic measuring element, centrally positioned; and the chart-driving mechanism, located near the rear. Each section has been designed with modular components to facilitate servicing and parts replacement. The chassis rolls in and out of the case freely on rigid tracks, and locks in both the service and the normal-operating positions. With the chassis in its service position, electrical connections are not broken; thus, adjustments and tests may be performed without interrupting recording operations.

INSTALLATION PROCEDURES

1) Before attempting to install the chassis into the instrument case, inspect the assembly carefully as follows:

(See Fig. A1)

a) Make sure all packing material is removed from the chassis.

b) See that chart transport is securely latched in its operating position, and that drive chain is engaging both sprocket gears on the side of the chassis.

c) See that the control panel assembly is latched in its lower position, and that control knobs turn freely in both directions.

d) Check connector at the rear of the chassis. If plug prongs are broken or bent, do not install chassis until corrective measures have been taken.

2) Slide chassis into front of case with chart transport facing outward. Push chassis about half way into case until it latches in the service position.

3) Press down on the small lever located on right side of chassis directly below chart-drive chain.

4) Continue to push chassis into case until chart drive latches securely.

5) If chassis is correctly installed, it will not slide forward, and the case door may be closed without touching internal parts.

> CAUTION: Do not attempt to slide chassis forward until panel and case are anchored firmly in position.

CONNECTIONS

Terminal connections are located at the rear of the recorder and are accessible by removing the case backplate. A terminal code plate reflecting all connections and ratings is located on the inside surface of the backplate--always refer to this plate and the wiring diagram supplied with this manual before making any electrical connections. This information is also listed on the Data Sheet furnished with the instrument.

Internal wiring is terminated at the rear of the case in a miniature Amphenol connector on all panel instruments; and at a screw-type terminal block on all portable models. Each connection is identified by a number, and this number will appear on the Terminal Code Plate when used as a function of the instrument. A mating Amphenol connector for external wiring is supplied with each flush instrument. Solder connections must be made to this unit and then its parts assembled before attaching it to the recorder connector.

Electromagnets within the recorder are designed to operate on voltages 15% over or under the rated value. Optimum performance will be obtained, however, by maintaining the input as near to the specified voltage as possible. Standard electrical ratings for electromagnets are given in the specifications.

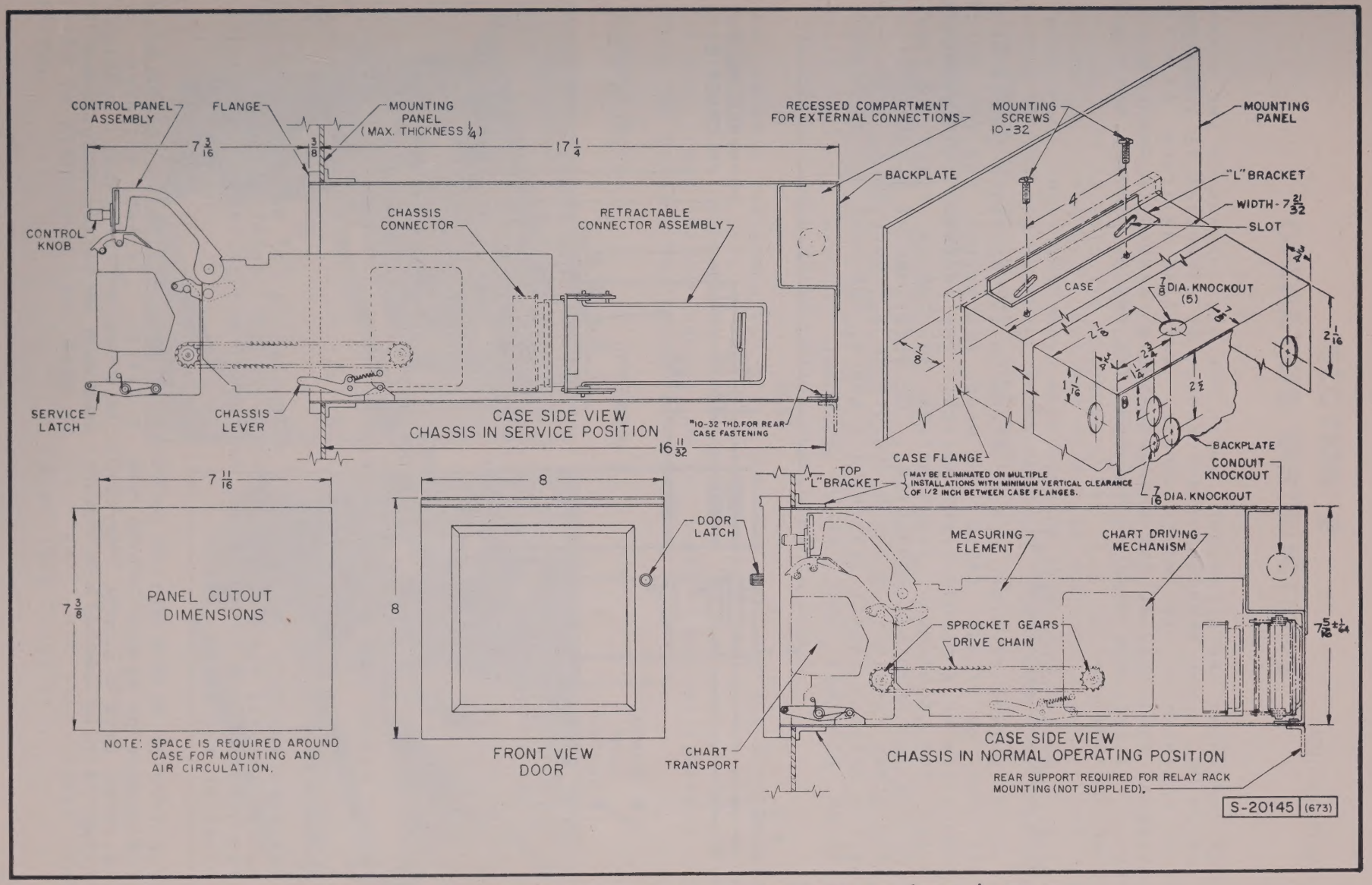


FIGURE A1. MOUNTING DIMENSIONS OF PANELGRAPH CASE ASSEMBLY.

FOR PERMANENT INSTALLATIONS WHERE THE ELECTROMAGNETS ARE OPERATED ON DC, EACH RECORDER INPUT SHOULD BE CONNECTED TO THE NEGATIVE POLARITY OF THE POWER SOURCE; EXTERNAL SWITCHES OR RELAY CONTACTS THAT ACTUATE THE ELECTROMAGNETS SHOULD BE CONNECTED TO THE POSITIVE POLARITY -- BETWEEN THE POWER SOURCE AND EACH ELECTROMAGNET.

CASE LIGHTING (PANELGRAPH)

THE SCREW-TYPE TERMINAL BLOCK, FOUND IN THE RECESSED COMPARTMENT AT THE REAR OF FLUSH CASES, IS MADE ACCESSIBLE FOR THE EXTERNAL CONNECTION OF A REMOTE LIGHT SWITCH. THE INTERNAL LAMP IS NORMALLY WIRED FOR CONTINUAL ILLUMINATION AS LONG AS POWER IS APPLIED THROUGH THE AMPHENOL CONNECTOR. BY REMOVING THE ELECTRICAL JUMPER FROM SCREW TERMINALS 3 AND 4 AND WIRING A SINGLE-POLE, SINGLE-THROW SWITCH BETWEEN SOCKET TERMINALS 1 AND 4, THE LAMP MAY BE TURNED OFF AND ON REMOTELY (SEE FIG. A2 BELOW).

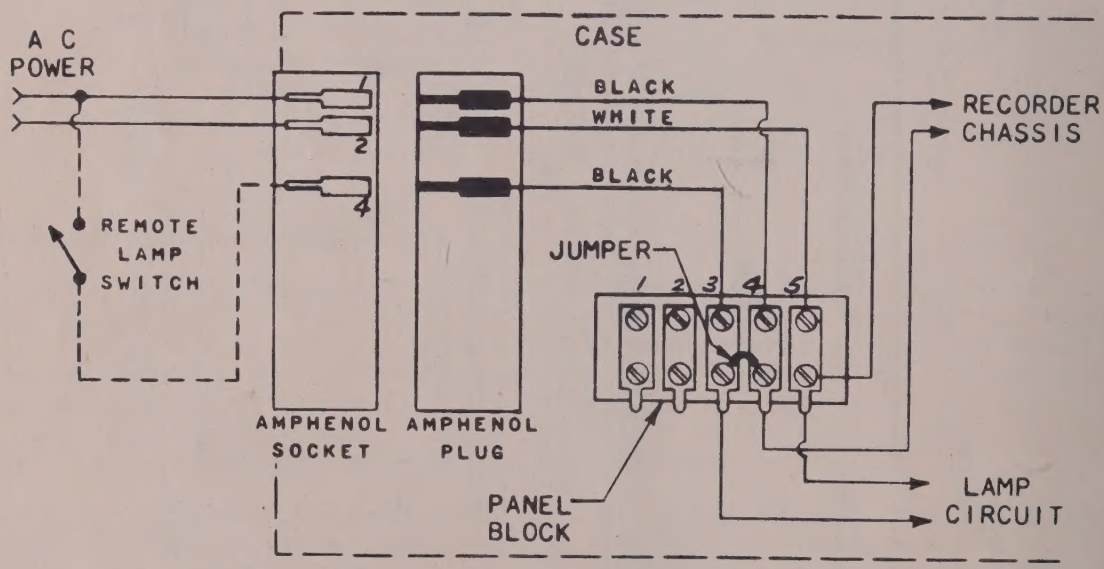


FIGURE A2. PANELGRAPH WIRING FOR REMOTE LIGHTING SWITCH.

REMOTE CONTROL

EXTERNAL SWITCHES MAY BE USED WITH SERIES "S" RECORDERS TO REMOTELY ACTUATE ELECTRICAL CONTROLS OF THE CHART DRIVE. THIS INCLUDES OFF-ON AS WELL AS THE HOUR, MINUTE, AND SECOND FUNCTIONS OF THE SPEED CONTROL.

THE TYPE OF REMOTE SWITCH OR SWITCHES REQUIRED WILL DEPEND UPON THE NUMBER OF REMOTE FUNCTIONS DESIRED. IF THE RECORDER IS EQUIPPED WITH A REMOTE PROVISION, SEE THE SUPPLEMENTAL INSTRUCTIONS IN THIS MANUAL FOR CONNECTIONS AND OPERATING PROCEDURES.

SECTION B
OPERATING INSTRUCTIONS

GENERAL

THIS INSTRUCTION SECTION COVERS OPERATION OF THE CHART DRIVE AND WRITING ELEMENTS EMPLOYED IN SERIES "S" EVENT RECORDERS. DO NOT ATTEMPT TO OPERATE THE RECORDER UNTIL ALL INSTRUCTIONS HAVE BEEN THOROUGHLY STUDIED. FAILURE TO FOLLOW PRESCRIBED PROCEDURES MAY RESULT IN UNSATISFACTORY OPERATION OR PERMANENT DAMAGE TO VITAL PARTS OF THE INSTRUMENT. IF RECOMMENDED PROCEDURES ARE FOLLOWED, THE RECORDER SHOULD GIVE CONTINUOUS TROUBLE-FREE SERVICE.

CHARTING PROCEDURES

FOLLOWING ARE INSTRUCTIONS FOR INSTALLING CHART PAPER IN SERIES "S" RECORDERS. TO MAINTAIN GUARANTEED ACCURACY AND INSURE OPTIMUM PERFORMANCE, ALWAYS USE ESTERLINE ANGUS PRECISION CHARTS IN THIS INSTRUMENT. PRIOR TO PERFORMING CHARTING PROCEDURES, MAKE SURE THAT ALL PACKING MATERIALS ARE REMOVED, AND THAT ALL INSTRUCTIONS UNDER INSTALLATION HAVE BEEN FOLLOWED.

ON LABGRAPH INSTRUMENTS, RAISE THE CASE LID AND SEE THAT CHART-DRIVE POWER IS OFF; ON PANELGRAPH RECORDERS, OPEN THE CASE DOOR AND SEE THAT CHART-DRIVE POWER IS OFF. PRESS DOWN ON THE LATCH IN THE LOWER RIGHT CORNER OF THE CHART TRANSPORT ASSEMBLY AND PULL THE CHASSIS OUT TO THE SERVICE POSITION.

LabGraph Models:

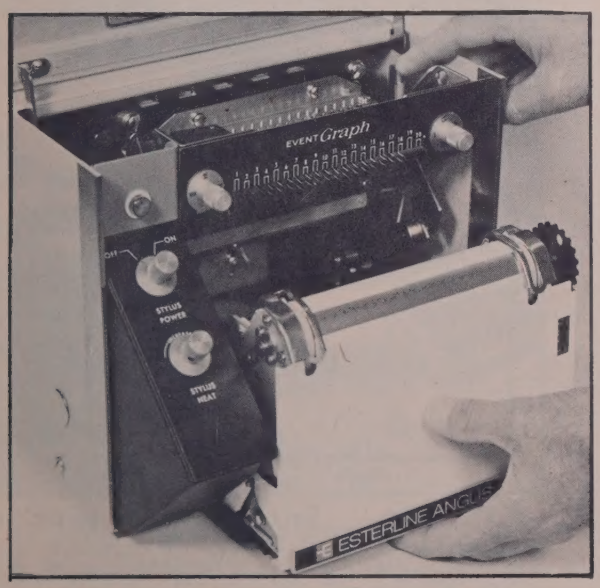


FIG. B1. PERMIT TRANSPORT ASSEMBLY TO TILT DOWN BY PRESSING LEVER ON RIGHT SIDE OF CASE AS SHOWN.

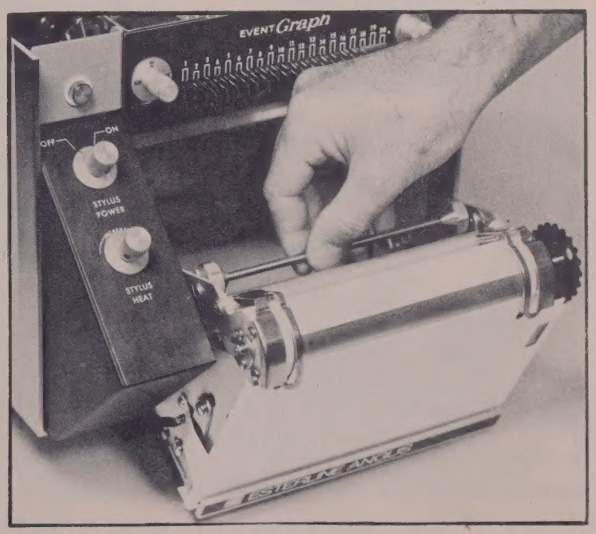


FIG. B2. REMOVE SUPPLY ROLL ARBOR BY PUSHING BACK AND LIFTING STRAIGHT UP. CENTER PAPER ROLL ON ARBOR (ELONGATED PERFORATIONS TO RIGHT) AND SNAP LOADED ARBOR BACK INTO TRANSPORT.

LabGraph Models:

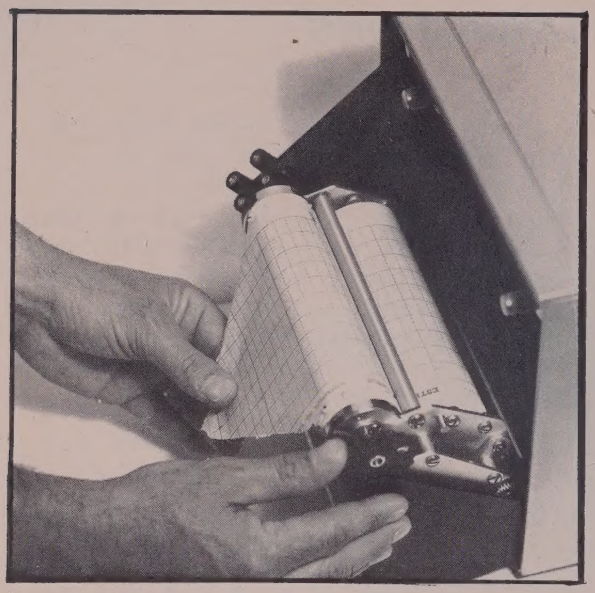


FIG. B3. TEAR OR CUT END OF PAPER TO "V"; TURN UP POINT SLIGHTLY AND FEED UNDER HOLD-DOWN BAR AND OVER TOP OF DRIVE ROLLER. TURN TIME-SET KNOB SO ROLLER PINS ENGAGE CHART PERFORATIONS.

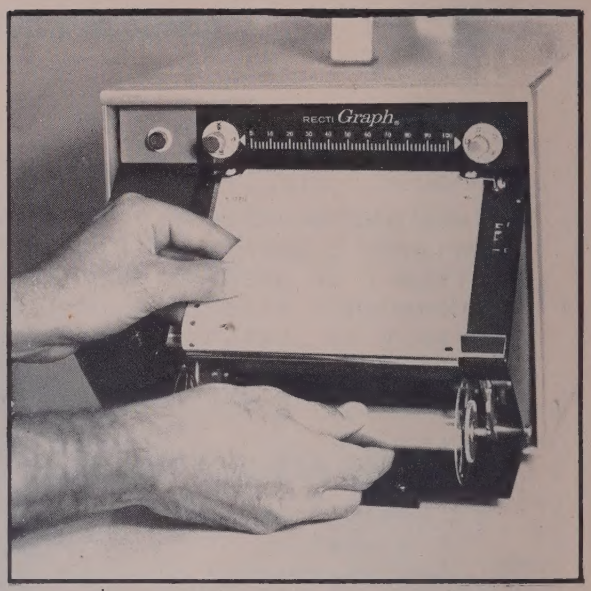


FIG. B4. SWING TRANSPORT UP TO OPERATING POSITION. OPEN DOOR AT BOTTOM OF TRANSPORT AND REMOVE REROLL CYLINDER BY LIFTING UP, THEN DOWN AND OUT AS SHOWN. KEEP CYLINDER STRAIGHT WHEN REMOVING OR INSTALLING.

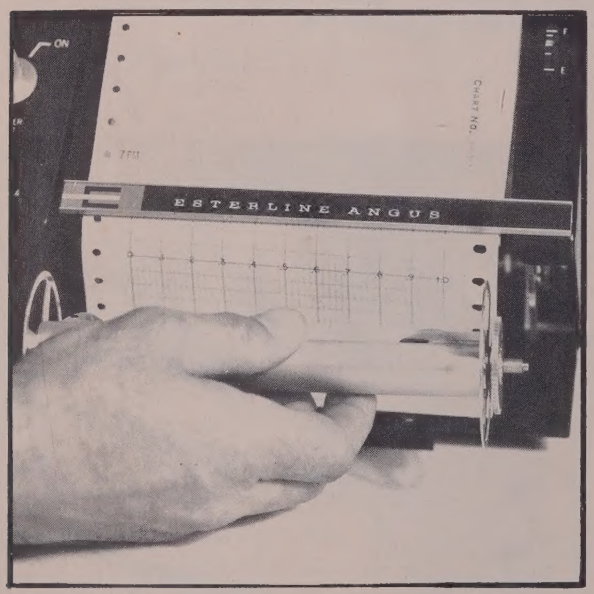


FIG. B5. HOLDING CYLINDER WITH GEAR END TO RIGHT, INSERT CHART INTO SLOT AND SLIDE PAPER-GUIDE DISK ON GEAR END OF CYLINDER OUTWARD. ROLL SEVERAL TURNS ON CYLINDER AND SLIDE GUIDE DISK INWARD JUST TO EDGE OF PAPER.

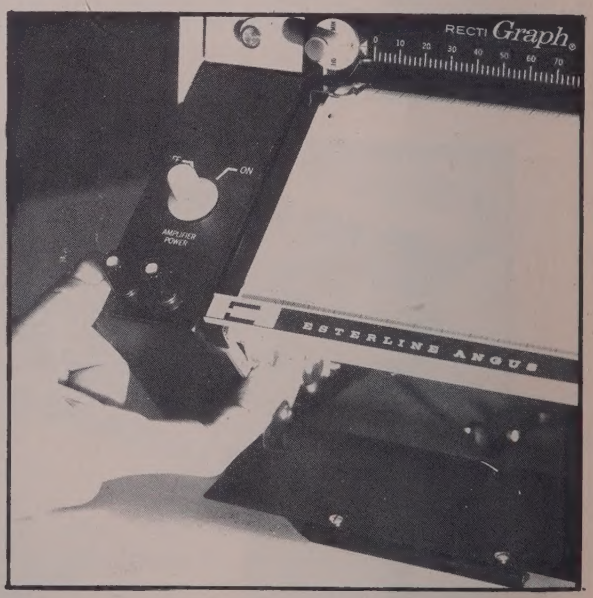


FIG. B6. SNAP REROLL BACK INTO TRANSPORT. TAKE UP CHART SLACK BY ROTATING DISK ON LEFT END OF REROLL CYLINDER AS SHOWN. TURN ON CHART DRIVE AND CHECK OPERATION. CHART MAY BE SET TO ANY DESIRED POSITION BY TURNING THE TIME-SET KNOB.

PanelGraph Models:

FIG. B7. PRESS DOWN ON RIGHT AND LEFT REROLL LATCH NEAR BOTTOM OF CHART TRANSPORT AND REMOVE REROLL CYLINDER AS SHOWN. KEEP CYLINDER STRAIGHT WHEN SNAPPING IT IN AND OUT OF TRANSPORT.

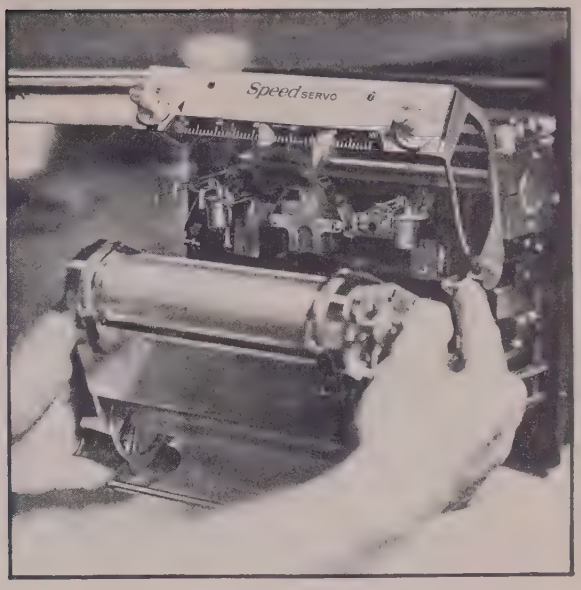


FIG. B8. RAISE SCALEPLATE UNTIL IT LATCHES IN POSITION. LIFT SMALL LEVER KNOB ON RIGHT SIDE OF TRANSPORT AND PERMIT ASSEMBLY TO TILT DOWN AS SHOWN.

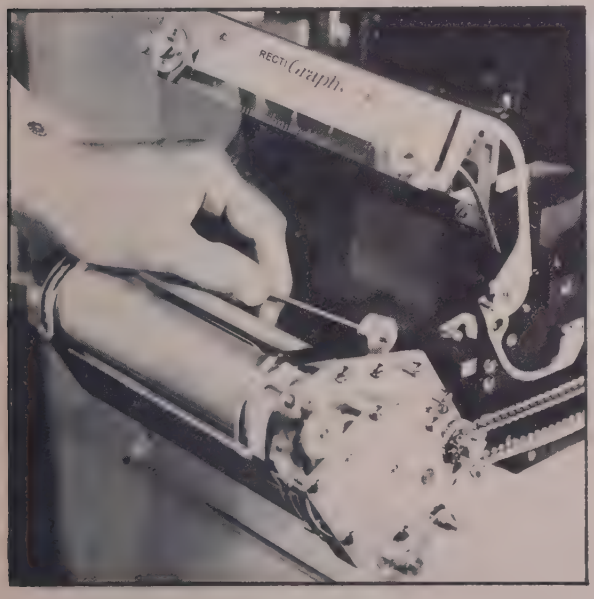


FIG. B9. REMOVE SUPPLY ROLL ARBOR BY PUSHING BACK AND LIFTING STRAIGHT UP. CENTER PAPER ROLL ON ARBOR (ELONGATED PERFORATIONS TO RIGHT) AND SNAP LOADED ARBOR BACK INTO TRANSPORT.

FIG. B10. TEAR OR CUT END OF PAPER TO "V"; TURN UP POINT SLIGHTLY AND FEED UNDER HOLD-DOWN BAR AND OVER TOP OF DRIVE ROLLER. TURN TIME-SET KNOB SO ROLLER PINS ENGAGE CHART PERFORATIONS.

PanelGraph Models:

FIG. B11. SWING TRANSPORT UP TO OPERATING POSITION. HOLDING CYLINDER WITH GEAR END TO RIGHT, INSERT CHART INTO SLOT AND SLIDE PAPER-GUIDE DISK ON GEAR END OF CYLINDER OUTWARD. ROLL SEVERAL TURNS ON CYLINDER AND SLIDE GUIDE DISK INWARD JUST TO EDGE OF PAPER.

FIG. B12. SNAP REROLL BACK INTO TRANSPORT. TAKE UP CHART SLACK BY ROTATING DISK ON LEFT END OF REROLL CYLINDER AS SHOWN. LOWER SCALEPLATE, TURN ON CHART DRIVE, AND CHECK OPERATION. CHART MAY BE SET TO ANY DESIRED POSITION BY TURNING THE TIME-SET KNOB.

INKING PROCEDURES (Model S620X)

THE FOLLOWING INSTRUCTIONS EXPLAIN HOW THE WRITING ELEMENTS ARE PREPARED FOR OPERATION. BEFORE FOLLOWING THESE STEP-BY-STEP PROCEDURES, UNPACK THE ACCESSORY KIT SUPPLIED AND MAKE SURE THAT ALL SHIPPING MATERIALS ARE REMOVED FROM THE INSTRUMENT. USE ONLY ESTERLINE ANGUS GRAPHIC INK; THIS WRITING FLUID IS ESPECIALLY FORMULATED TO SATISFY THE EXACTING REQUIREMENTS OF RECORDING INSTRUMENTS. KEEP THE INK CONTAINER TIGHTLY CAPPED TO MINIMIZE EVAPORATION AND TO PREVENT DIRT FROM CONTAMINATING THE FLUID. INK MAY BEGIN TO THICKEN AT LOW TEMPERATURES, THEREFORE, HEAT MUST BE PROVIDED IN THE RECORDER IF TEMPERATURES REMAIN BELOW 20°F.

NOTE: TO INSTALL CHART PAPER, REFER TO "CHARTING PROCEDURES" ELSEWHERE IN THIS SECTION.

INKING

PANEL MODELS

(1) SLIDE OUT CHASSIS TO SERVICE POSITION.

(2) RAISE SCALEPLATE ASSEMBLY AND LOWER CHART TRANSPORT.

(3) REMOVE PENS #12 AND #13 (IF USED) FROM INKWELL.

(4) LOWER SCALEPLATE AND CAREFULLY FILL INKWELL THROUGH FILLER HOLE USING SYRINGE SUPPLIED.

NOTE: FILL INKWELL 3/4 FULL (APPROX. 1 OZ.).

(5) RAISE SCALEPLATE AND REPLACE PENS #12 AND #13 IN INKWELL. SEE THAT ALL PEN TAILS ENGAGE ELECTROMAGNET ARMS.

LAB MODELS

(1) RAISE CASE LID AND REMOVE SCALEPLATE.

(2) LOWER CHART TRANSPORT AND REMOVE PENS #12 AND #13 (IF USED) FROM INKWELL.

(3) CAREFULLY FILL INKWELL THROUGH FILLER HOLE USING SYRINGE SUPPLIED.

NOTE: FILL INKWELL 3/4 FULL (APPROX. 1 OZ.).

(4) REPLACE PENS #12 AND #13 IN INKWELL AND SEE THAT ALL PEN TAILS ENGAGE ELECTROMAGNET ARMS.

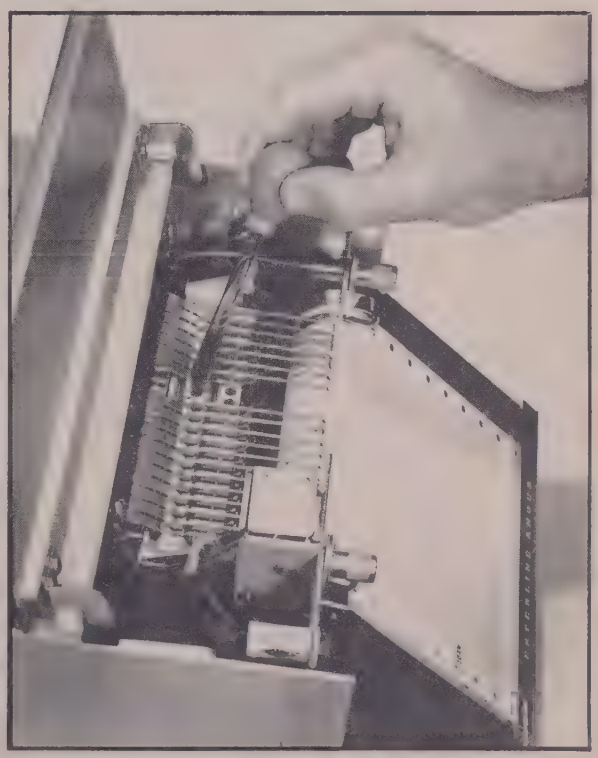


FIGURE B13. FILLING INKWELL (LABGRAPH SHOWN).

CAUTION: DO NOT OVERFLOW INKWELL. IF INK IS SPILLED WITHIN INSTRUMENT, CLEAN IMMEDIATELY.

PRIMING

FLUSH MODELS

(1) Raise scaleplate assembly and latch chart transport in operating position.

(2) Compress pen-filler bulb and insert pen point into hole in rubber tip of bulb.

(3) Release bulb slowly until ink appears in glass tube.

(4) Remove rubber tip from pen point and repeat priming procedure for each pen.

(5) Turn on chart drive and check inking; if satisfactory, lower scaleplate assembly and slide chassis into case.

PORTABLE MODELS

(1) Remove scaleplate and latch chart transport in operating position.

(2) Compress pen-filler bulb and insert pen point into hole in rubber tip of bulb.

(3) Release bulb slowly until ink appears in glass tube.

(4) Remove rubber tip from pen point and repeat priming procedure for each pen.

(5) Turn on chart drive and check inking; if satisfactory, replace scaleplate and lower case lid.

Figure B14. Priming Pens (LabGraph shown).

NOTE: Ink accumulated in pen filler may be forced back into inkwell through pen points.

To avoid clogging of the inking system it is recommended that the inkwell be kept 1/4 full of EA ink. A toothpick or match stick may be used to check ink level. If pen prime is lost, tap lightly on top of the pen and advance the chart paper. If this fails to restore writing, repeat the priming procedures. Wash all inking equipment with clear water after each use. For further information on cleaning the inking system, see the Maintenance procedures in this instruction section.

CAUTION: Do not attempt to remove the sealed inkwell cover.

OPERATING PROCEDURES

CONTROLS

Chart drive controls are located on the scaleplate panel directly above the chart transport assembly. All chart drives with single-speed transmissions will have an OFF-ON switch at the left end of this panel. For drives providing both single-hour and single-minute speeds with electric speed control, the panel switch will have a three-position sequence of: OFF/HOUR/MINUTE. Single feed-rate drives providing hour-, minute-, and second-speeds with electric speed control will have a four-position switch sequence of: OFF/HOUR/MINUTE/SECOND.

All chart drives featuring multi-speed transmissions will also have a feed-rate selector switch located at the right end of the scaleplate panel. This switch permits the operator to select any one of five different transmission speeds (or chart feed rates). The control knob is calibrated in inches, and will normally have a five-position sequence of: .75, 1.5, 3, 6, and 12. The operator may rotate this panel knob in either direction to select the desired rate of feed.

To operate a chart drive incorporating a multi-speed transmission with electric speed control, the knob on the left of the panel is placed in the desired time-rate position (HR, MIN, or SEC); and the knob on the right is set to the desired chart feed rate (in inches). Chart speed may be changed at any time by re-setting either knob with the chart in motion or at rest. To stop the chart paper, rotate the switch on the left to its "OFF" position.

HEAT ADJUST (S620T)

To operate a recorder using heated styluses, proceed with the following steps:

(1) Turn on STYLUS HEAT switch (Fig. B15).

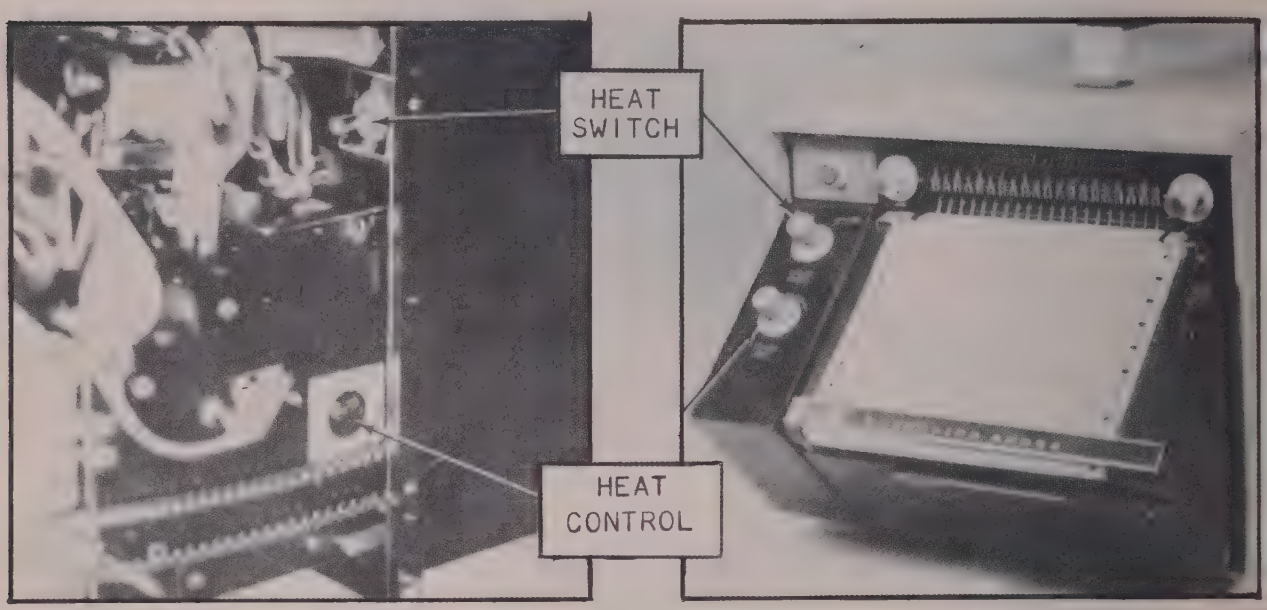
(2) After 5-second warm-up, turn on chart drive.

(3) Adjust STYLUS HEAT control for desired line contrast (Fig. B15).

> NOTE: This is a screwdriver adjustment on all flush models.

(4) Check writing characteristics of styluses by energizing electromagnets with chart in motion.

> NOTE: To prevent styluses from sticking to chart paper, always turn off heat switch 5 or 10 seconds before stopping chart drive.



FLUSH MODELS PORTABLE MODELS

Figure B15. Location of Stylus Heat Controls.

RECORDING CHARTS

To maintain instrument accuracy and to insure optimum performance, only Esterline Angus precision charts should be used with this recorder. Charts with appropriate time markings are available for operation with any chart speed in "inches per hour". Blank charts and those without time markings are available for intermittent operation or for applications where occurrence time of a variable is not important. In addition to these stock items, Esterline Angus produces customized charts with special rulings and range numbers. Consult the factory or your local EA representative for additional information on these special charts.

The chart record may be inspected at any time during operation by unwinding the paper from the reroll cylinder. With the chart drive in operation, the reroll system functions at all times and will reroll any portion of chart unwound for inspection. If desired, the reroll action may be speeded-up without throwing the

CHART OUT OF TIME BY HOLDING THE TIME-SET KNOB AND MANUALLY ROTATING THE DISK ON EITHER END OF THE REROLL CYLINDER. IF A LARGE PORTION OF THE CHART MUST BE REROLLED, THE CYLINDER SHOULD BE REMOVED AND THE CHART REROLLED BY HAND OR ON AN ESTERLINE ANGUS "CHART INSPECTOR".

INSTEAD OF REROLLING THE CHART PAPER ON THE REROLL CYLINDER, IT MAY BE FED STRAIGHT OUT OF THE INSTRUMENT. IF FEEDING DIFFICULTY IS ENCOUNTERED AT FAST CHART SPEEDS, IT MAY BE NECESSARY TO ATTACH A WEIGHT TO THE PAPER AS IT FEEDS FROM THE INSTRUMENT. A FIVE- OR SIX-OUNCE CLAMP-ON DEVICE IS SUFFICIENT FOR THIS PURPOSE. DO NOT PULL OR JERK DOWNWARD ON THE CHART AS THIS MAY EITHER THROW IT OUT OF TIME, OR DISENGAGE IT FROM THE PINS ON THE DRIVE ROLLER. IN THE LABGRAPH MODEL, THE BAR AT THE BOTTOM OF THE WRITING TABLE MAY BE USED AS A TEAR-OFF EDGE BY PULLING THE CHART STRAIGHT UP FROM ONE SIDE TO THE OTHER; IN THE PANELGRAPH, USE THE BOTTOM EDGE OF THE DOOR BY PULLING STRAIGHT OUTWARD AND FROM ONE SIDE TO THE OTHER.

IF CONTINUOUS RECORDS ARE DESIRED, BE SURE TO CHECK THE CHART INDICATOR REGULARLY. THE INDICATOR IS POSITIONED ON THE RIGHT SIDE OF THE WRITING TABLE SURFACE ON LABGRAPH MODELS AND ON THE RIGHT-FRONT SIDE OF THE TRANSPORT ASSEMBLY ON THE PANELGRAPH MODELS. AT THE TOP OF ITS SCALE IS FOUND THE LETTER "F" -- INDICATING A FULL CHART ROLL; AND, AT THE BOTTOM OF THE SCALE IS THE LETTER "E" -- INDICATING A NEAR EMPTY SUPPLY ROLL. IN ADDITION TO THIS AUTOMATIC INDICATOR, A WARNING WILL APPEAR NEAR THE END OF EACH CHART ROLL WHICH INDICATES THAT ONLY A FEW FEET OF UNUSED CHART REMAIN.

CHART REMOVAL

A REROLLED CHART MAY BE REMOVED FROM THE INSTRUMENT BY PROCEEDING WITH THE FOLLOWING STEPS:

LABGRAPH MODEL:

1) TURN OFF CHART DRIVE AND OPEN SMALL DOOR AT BOTTOM OF TRANSPORT.

2) GRASP CHART ON REROLL CYLINDER, LIFT UP, AND REMOVE FROM INSTRUMENT. KEEP ROLL STRAIGHT WHEN REMOVING.

3) REMOVE GEAR PLUG FROM RIGHT END OF REROLL CYLINDER.

4) SLIDE CHART ROLL FROM OPEN END OF CYLINDER. IF CHART IS TOO TIGHTLY WOUND, CAREFULLY TWIST PAPER ROLL COUNTER-CLOCKWISE AS IT IS BEING WITHDRAWN FROM CYLINDER. PLACE GEAR PLUG BACK INTO END OF CYLINDER -- MAKING SURE THAT SMALL KEY PIN ON PLUG ENGAGES SLOT IN CYLINDER (FIG. D5).

PanelGraph Model:

1) Turn off chart drive and pull chassis out to service position.

2) Press down on side latches and remove reroll cylinder and chart. Keep roll straight when removing.

3) Remove gear plug from right end of reroll cylinder.

4) Slide chart roll from open end of cylinder. If chart is too tightly wound, carefully twist paper roll counter-clockwise as it is being withdrawn from cylinder. Place gear plug back into end of cylinder -- making sure that locating pin on plug engages slot in cylinder (Fig. D5).

An Esterline Angus "chart inspector" is recommended for use when examining completed records. This accessory is a convenient tool for inspecting the record, making notes on the paper, and rerolling charts for storage.

Always keep enough EA charts on hand to operate the recorder for at least one month. By purchasing in large quantities worthwhile savings can be realized. Strip charts must be ordered by assigned number, which will be found on the right-hand edge of each printed chart.

Esterline Angus charts are currently available in useful lengths of 103 feet (ink types); and 81 feet (thermal types). The total running time for any chart will of course depend upon the chart speed employed. Chart running times, for various chart speeds, are shown in the following table. Chart drives capable of producing these recording periods are also listed.

APPLICATIONS

Any electrical, mechanical, or physiological event that can be represented by an off-on condition may be recorded on the EventGraph. Events are recorded by opening or closing external circuitry connected to the recorder. The phenomenon to be studied may, however, be mechanical or physiological in nature rather than electrical; in this case, switches or connectors of some sort must be used to convert the phenomenon into electrical impulses. Several basic applications are illustrated in Fig. B16.

Various switches, relays, and contact-making devices are commercially available for application with physical movement. Some of these are cam types, centrifugal types, extended-lever

RECORDING TIMETABLE

CHART CHARACTERISTICS				APPLICABLE CHART DRIVES (STYLE NUMBER)											
STANDARD CHART SPEED	TRAVEL TIME PER INCH	MINIMUM CONTINUOUS RUNNING TIME*		200	203	206	209	212	215	218	221	224	227	232	234
		INK CHARTS	THERMAL CHARTS												
3/4 IN/HR.	80 MIN.	65-2/3 DAYS	51 DAYS	x	x					x	x	x	x		x
1-1/2 IN/HR.	40 MIN.	32-1/3 DAYS	25-1/2 DAYS	x	x					x	x	x	x		x
3 IN/HR.	20 MIN.	15-2/3 DAYS	12-3/4 DAYS	x	x					x	x	x	x		x
6 IN/HR.	10 MIN.	7-1/3 DAYS	6-3/8 DAYS	x	x					x	x	x	x		x
12 IN/HR.	5 MIN.	3-2/3 DAYS	3-3/16 DAYS	x	x					x	x	x	x		x
3/4 IN/MIN.	80 SEC.	26-2/3 HOURS	20-4/5 HOURS			x	x			x	x	x	x	x	
1-1/2 IN/MIN.	40 SEC.	13-1/3 HOURS	10-2/5 HOURS			x	x			x	x	x	x	x	
3 IN/MIN.	20 SEC.	6-2/3 HOURS	5-1/5 HOURS			x	x			x	x	x	x	x	
6 IN/MIN.	10 SEC.	3-1/3 HOURS	2-3/5 HOURS			x	x			x	x	x	x	x	
12 IN/MIN.	5 SEC.	1-2/3 HOURS	1-3/10 HOURS			x	x			x	x	x	x	x	
3/4 IN/SEC.	1.33 SEC.	26-2/3 MINUTES	20-3/4 MINUTES					x	x			x	x	x	x
1-1/2 IN/SEC.	667 MS.	13-1/3 MINUTES	10-3/8 MINUTES					x	x			x	x	x	x
3 IN/SEC.	333 MS.	6-2/3 MINUTES	5-3/16 MINUTES					x	x			x	x	x	x
6 IN/SEC.	167 MS.	3-1/3 MINUTES	2-5/8 MINUTES					x	x			x	x	x	x

* ALL CALCULATIONS TAKE INTO CONSIDERATION 3 FEET OF CHART FOR INSTALLATION. CHARTS FOR HOUR SPEEDS ALSO ALLOW FOR THE LOSS OF AN ENTIRE 24-HOUR PERIOD, SO THAT THEY MAY ALWAYS BE SET TO THE TIME OF DAY.

TYPES, AND BRUSH OR FINGER TYPES. WHERE PHYSICAL CONTACT WITH AN OBJECT IS IMPOSSIBLE, PHOTO-ELECTRIC RELAYS MAY BE USED AS EVENT COUNTERS. SINCE A PHOTO-CELL CIRCUIT CAN BE MADE TO RESPOND TO THE PRESENCE OR ABSENCE OF LIGHT, IT MAY BE USED TO INDICATE THE PRESENCE OF A FLAME, A GLOWING OBJECT, OR THE ON--OFF CONDITION OF ANY LIGHT SOURCE. SWITCHES ARE AVAILABLE THAT WILL CLOSE ELECTRICAL CONTACTS WHEN A DESIRED PRESSURE OR VACUUM EXISTS. THERMOSTATS, TIMERS, FLOAT SWITCHES, AND MANY OTHER DEVICES ARE AVAILABLE TO CONVERT A PHENOMENON STIMULUS INTO ELECTRICAL IMPULSES. THE IMPULSES ARE THEN APPLIED TO THE EVENT RECORDER AND AN INTELLIGIBLE RECORD IS OBTAINED.

METHODS OF ACTUATING THE ELECTROMAGNETS WILL DEPEND UPON THE TYPE OF INSTRUMENT SELECTED. THERE ARE THREE BASIC TYPES AVAILABLE: A VOLTAGE TYPE WITH COMMON RETURN CONNECTIONS, A VOLTAGE TYPE WITH ISOLATED OR SEPARATE-RETURN CONNECTIONS, AND A SWITCH TYPE WITH A COMMON RETURN CIRCUIT FOR ALL ELECTROMAGNETS. IN A VOLTAGE-TYPE COMMON-RETURN INSTRUMENT, ONE SIDE OF ALL ELECTROMAGNET COILS IS CONNECTED TO A COMMON LEAD WHICH MAY BE TERMINATED IN ONE OR MORE PIN CONNECTIONS AT THE REAR OF THE INSTRUMENT. THE OTHER SIDE OF EACH COIL IS TERMINATED AT INDIVIDUAL PIN CONNECTIONS, WHICH ARE CONNECTED TO INDIVIDUAL IMPULSE SOURCES. THIS TYPE OF INSTRUMENT WILL FREQUENTLY BE USED IN THE STUDY OF TIMING CYCLES FOR A NUMBER OF AUTOMATICALLY CONTROLLED PROCESSES.

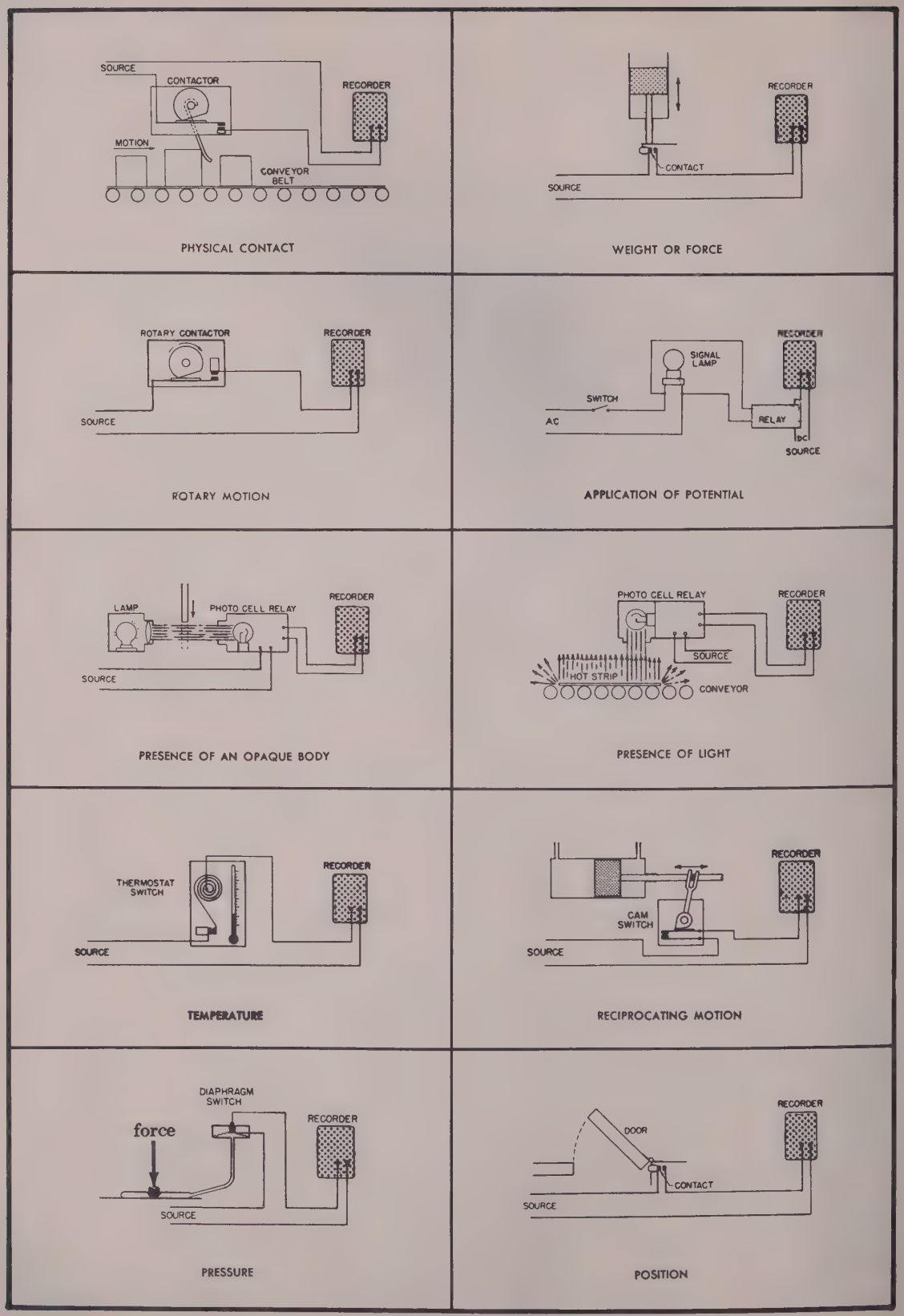


FIG. B16. SHOWN ABOVE ARE ONLY A FEW OF MANY METHODS THAT MAY BE USED TO ACTUATE EVENTGRAPH RECORDERS.

WHERE THE CONDITION OR PHENOMENON TO BE RECORDED IS MECHANICAL RATHER THAN ELECTRICAL, SWITCHES OR CONNECTORS MAY BE USED TO INTERRUPT AN EXTERNAL VOLTAGE SOURCE, AND THUS CONVERT THE CONDITION TO ELECTRICAL IMPULSES. THE CONTACT-MAKING DEVICE MAY BE OPERATED FROM MECHANICAL ROTATION OR THRUST, FROM CHANGING POSITION, OR FROM CHANGES IN PRESSURE, TEMPERATURE, OR LIGHT INTENSITY.

IN THE VOLTAGE-TYPE SEPARATE-RETURN INSTRUMENTS, EACH SIDE OF THE ELECTROMAGNET COIL IS TERMINATED AT AN INDIVIDUAL PIN CONNECTION ON THE REAR OF THE INSTRUMENT. THIS TYPE OF RECORDER IS USED WHERE THE ELECTROMAGNET CIRCUITS MUST NOT BE INTERCONNECTED. THE USE OF THIS TYPE OF RECORDER WILL OFTEN ELIMINATE THE NEED FOR DETERMINING POLARITIES AND SIMPLIFIES INSTALLATION.

IN CERTAIN APPLICATIONS WHEN AN EXTERNAL SWITCH IS OPEN, A POTENTIAL MAY STILL REMAIN ON THE LEAD CONNECTED TO THE ELECTROMAGNET. SUCH A SAFETY HAZARD CAN USUALLY BE AVOIDED BY USING THE SEPARATE-RETURN TYPE INSTRUMENT.

THE SWITCH-TYPE INSTRUMENT IS USED WHERE THE RECORDED EVENT MECHANICALLY ACTUATES A SWITCH OR CONNECTOR. THERE MUST BE NO VOLTAGE EXISTING IN THE INDIVIDUAL EVENT CIRCUITS. AN EXTERNAL STEP-DOWN TRANSFORMER IS USED TO SUPPLY APPROXIMATELY 24-VOLTS AC TO ACTUATE THE ELECTROMAGNETS. ONE SIDE OF THE SECONDARY OF THIS TRANSFORMER IS CONNECTED TO ONE SIDE OF EACH COIL WITHIN THE INSTRUMENT, AND THE OTHER SIDE OF THE SECONDARY IS CONNECTED IN SERIES WITH THE EXTERNAL SWITCHES. THE SWITCHES ARE INDIVIDUALLY CONNECTED TO THE ELECTROMAGNETS WITHIN THE RECORDER. SOME APPLICATIONS OF THE SWITCH-TYPE INSTRUMENT ARE THE RECORDING OF MOVEMENTS, THE PRODUCTIVE AND IDLE TIME OF MACHINERY, THE PASSAGE OF OBJECTS ON A CONVEYOR, THE FLOW OF LIQUID, AND THE REVOLUTION OF A SHAFT.

EITHER THE SWITCH-TYPE OR VOLTAGE-TYPE OF RECORDER MAY BE USED WHERE SWITCHES, CONTACTS, OR RELAYS OPERATE THE ELECTROMAGNETS AND WHERE THE SOURCE IS AC. THE USE OF THE SWITCH TYPE, HOWEVER, PERMITS LOWER OPERATING VOLTAGES WHICH MAKES POSSIBLE A REDUCTION IN WIRING COSTS, AND ALSO ELIMINATES THE HAZARDS OF HIGH VOLTAGES. THE VOLTAGE-TYPE RECORDER MUST BE USED WHEN ONLY DC VOLTAGE IS AVAILABLE.

THERE ARE SOME APPLICATIONS WHERE THE APPLIED VOLTAGE MAY VARY OVER TOO WIDE A RANGE FOR SATISFACTORY OPERATION OF A VOLTAGE--TYPE RECORDER, OR WHERE CURRENTS ARE TOO LARGE TO BE BROUGHT DIRECTLY TO THE INSTRUMENT. IN SUCH INSTANCES, APPROPRIATE RELAYS SHOULD BE CONNECTED INTO THE CIRCUITS TO PROVIDE THE NECESSARY ON-OFF IMPULSES.

IN ALL APPLICATIONS OF EVENTGRAPHS, IT IS ESSENTIAL THAT THE INSTRUMENT RESPOND ONLY WHEN THE DESIRED ACTION TAKES PLACE. THIS MAY INVOLVE THE FULFILLING OF TWO OR MORE CONDITIONS SIMUL-

TANEOUSLY. IN SUCH CASES, TWO OR MORE SWITCHES MAY BE USED IN SERIES; THE ELECTROMAGNET BEING ENERGIZED ONLY WHEN BOTH SWITCHES ARE CLOSED.

IN OTHER APPLICATIONS IT MAY BE DESIRABLE TO TOTAL THE NUMBER OF EVENTS FOR A CERTAIN PERIOD OF TIME. THIS FUNCTION MAY BE OBTAINED AUTOMATICALLY BY CONNECTING A COUNTER IN PARALLEL WITH EACH ELECTROMAGNET OF A VOLTAGE-TYPE RECORDER. AN ALTERNATE METHOD WOULD BE TO CONNECT A SELF-STARTING SYNCHRONOUS CLOCK IN PLACE OF THE COUNTER; THE CLOCK WILL RUN ONLY WHEN THE ELECTROMAGNET IS ENERGIZED, AND WILL THUS TOTALIZE THE NUMBER OF EVENTS.

INTERPRETING RECORDS

THERE ARE THREE BASIC RECORD PATTERNS THAT MAY BE OBTAINED WITH THE EVENTGRAPH. THESE TYPES ARE THE RECTANGLE, BAND, AND IMPULSE PATTERNS SHOWN IN FIG. B17. THE CHARACTERISTICS OF EACH WILL DEPEND UPON THE FOLLOWING RELATIONS: LENGTH OF TIME THE INK- OR STYLUS-PEN IS ENERGIZED, THE TIME THE PEN IS DE-ENERGIZED, AND THE CHART SPEED.

THE MOST COMMON TYPE OF RECORD IS THE RECTANGULAR PATTERN. IN THIS INSTANCE, THE ELECTROMAGNET IS ENERGIZED ONLY WHEN SOME EVENT CONDITION OCCURS; ENERGIZING TIME BEING LONG ENOUGH FOR THE PEN TO PRODUCE A CLEARLY-DEFINED RECTANGLE ON THE CHART. ALTHOUGH THE CHART SPEED IS NOT CRITICAL, SPEEDS SHOULD BE EMPLOYED THAT ARE NO HIGHER THAN NECESSARY TO OBTAIN THE REQUIRED ACCURACY IN TIME MEASUREMENTS.

A BAND TYPE RECORD MAY BE PRODUCED BY HAVING THE RECORDER PEN ACTUATED BY RAPIDLY-CHANGING EVENTS OR BY RUNNING THE CHART AT A VERY SLOW SPEED. CHART SPEED AND METHOD OF ACTUATION SHOULD BE CHOSEN SO THAT THE CYCLE OCCURS WITH ENOUGH RAPIDITY (IN COMPARISON TO CHART TRAVEL) TO CAUSE THE PEN TO PRODUCE OVER-LAPPING MARKS. THERE SHOULD NOT BE LESS THAN 80 STROKES AND NOT MORE THAN 200 STROKES OF THE PEN PER-INCH OF CHART IN THE BAND PATTERN.

AN IMPULSE PATTERN IS OBTAINED WHEN THE PEN IS ENERGIZED ONLY MOMENTARILY. THE RETURN STROKE OF THE PEN FALLS ON PRACTICALLY THE SAME PATH AS THE ACTIVE STROKE, SO THAT EACH EVENT PRODUCES A SINGLE LINE ON THE CHART. THE NUMBER OF MARKS PER GIVEN TIME, AND THE SPACING BETWEEN THEM, MAY BE ACCURATELY DETERMINED. WHEN IT IS DESIRED TO COUNT INDIVIDUAL EVENTS, THERE SHOULD BE NOT MORE THAN 30 STROKES OF THE PEN PER-INCH OF CHART PAPER.

IN SOME APPLICATIONS, IT MAY BE DESIRABLE TO DISPLAY A COMBINATION OF PATTERNS TO PROPERLY ANALYZE A CERTAIN EVENT. AS SHOWN IN THE COMBINATION PATTERN OF FIG. B17, ONE TYPE OF RECORD CAN OFTEN BE CONVERTED TO ANOTHER BY CHANGING CHART SPEEDS. AN OPERATOR MAY BE RECORDING AN EVENT FOR A LONG PERIOD USING A BAND PATTERN, BUT THEN CHOOSE TO EXAMINE INDIVIDUAL STROKES OF THE PEN MORE CLOSELY. IN MOST CASES, HE WILL BE ABLE TO OBTAIN EITHER AN IMPULSE OR RECTANGULAR PATTERN BY MERELY INCREASING

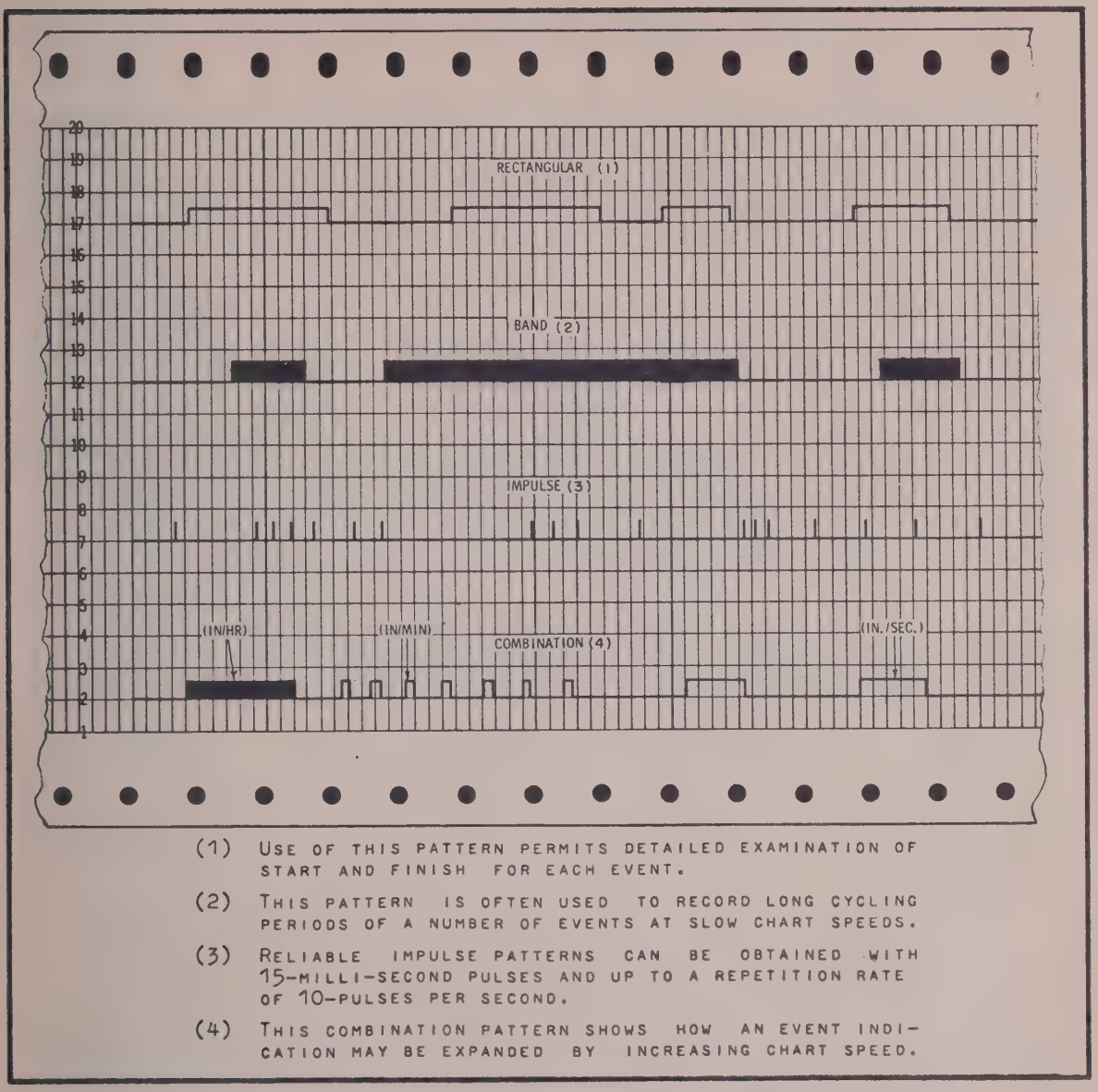

RECTANGULAR (1)
BAND (2)
IMPULSE (3)
(IN/HR)
(IN/MIN)
COMBINATION (4)
(IN./SEC.)
(1) USE OF THIS PATTERN PERMITS DETAILED EXAMINATION OF START AND FINISH FOR EACH EVENT.
(2) THIS PATTERN IS OFTEN USED TO RECORD LONG CYCLING PERIODS OF A NUMBER OF EVENTS AT SLOW CHART SPEEDS.
(3) RELIABLE IMPULSE PATTERNS CAN BE OBTAINED WITH 15-MILLI-SECOND PULSES AND UP TO A REPETITION RATE OF 10-PULSES PER SECOND.
(4) THIS COMBINATION PATTERN SHOWS HOW AN EVENT INDICATION MAY BE EXPANDED BY INCREASING CHART SPEED.

FIG. B17. EVENT RECORDER PATTERNS.

CHART SPEED. THE VARIOUS PATTERNS MAY REPRESENT A COMPLEX PROCESS OR SYSTEMS CYCLING WHERE THE TIME FOR INDIVIDUAL EVENTS CAN BE DETERMINED OR TOTALIZED.

ONE TYPE OF GRAPHIC PATTERN PRODUCED BY SEVERAL DIFFERENT EVENT CONDITIONS MAY BE INTERRUPTED BY ANOTHER TYPE OF PATTERN IN ORDER TO IDENTIFY TIME PERIODS FOR INDIVIDUAL EVENTS. THE TYPE OF PATTERN SELECTED WILL OF COURSE DEPEND UPON THE PARTICULAR APPLICATION AND NATURE OF RECORDING DATA DESIRED.

TO PREVENT FALSE RECORDS, BOTH CURRENT AND VOLTAGE RELAYS MAY BE USED TO ENERGIZE AN EVENT PEN. SPECIAL SHIELDING OR FILTERING MAY ALSO BE NECESSARY TO ELIMINATE EXTERNAL INTERFERENCE OR INTER-ACTION BETWEEN EVENT CIRCUITS.

SECTION C

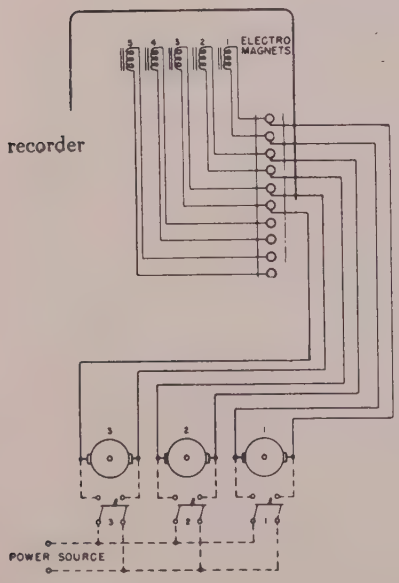
PRINCIPLES OF OPERATION

RECORDING SYSTEM

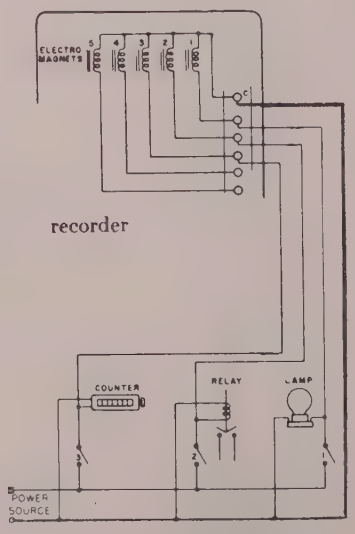
These E-A instruments are designed to record event information from as many as twenty different sources simultaneously, and on a single chart 6" in width. The writing elements record time and duration of events on separate channels. Each element is actuated by a small electromagnet, which in turn is connected to the circuit or system being monitored. When the electromagnet is energized, the element is displaced approximately 1/10" from a reference line on the chart. When the electromagnet is de-energized, the element automatically returns to its reference.

The electromagnet coils are operated by either AC or DC voltages in a number of circuit configurations -- depending upon the particular type ordered. Standard configurations are shown below. Each electromagnet assembly consists of a coil winding, an iron core, and a lever-type armature. The coils are wired to terminal connectors on the rear of the instrument.

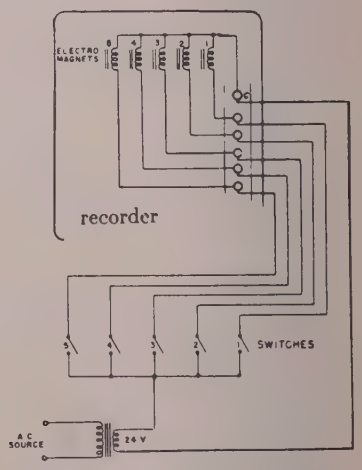
Inkless event recorders with "Tempen" have an internal stylus-heating circuit especially designed to produce graphic records without smoke, fumes, or odor. All styluses are connected in series and are heated by a direct-current source.



—Wiring diagram of voltage type, separate return recorder. Separate return circuits are available only on voltage type recorders.



—Wiring diagram of voltage type, common return recorder actuated by line voltage across signal lamps, relays or counters.



—Wiring diagram of switch type recorder. This instrument is furnished only with common return circuits.

Figure C1. Optional Event-Circuit Configurations.

CHART DRIVE SYSTEM

THE CHART DRIVE IS AN ELECTRO-MECHANICAL DEVICE THAT CONVERTS ELECTRICAL ENERGY INTO LINEAR PHYSICAL MOTION THROUGH THE USE OF A MOTOR POWER SOURCE AND VARIOUS GEAR ASSEMBLIES. THE BLOCK DIAGRAM OF FIG. C2 ILLUSTRATES AN ENTIRE CHART DRIVE SYSTEM. THE BLOCKS ENCIRCLED BY BROKEN LINES ARE OPTIONAL COMPONENTS, AND THEIR USE WILL DEPEND UPON THE PARTICULAR STYLE OF DRIVE SELECTED.

THE MOTOR DRIVE ASSEMBLY (FIG. C2) CONSISTS OF A SYNCHRONOUS MOTOR AND REDUCTION GEAR HEAD. THE SYNCHRONOUS MOTOR MUST BE OPERATED FROM A FREQUENCY-REGULATED SOURCE OF A. C. POWER. THE GEAR HEAD PROVIDES A 60-TO-1 SPEED CHANGE. WHEN THIS FEATURE IS USED, THE OPERATOR MAY SELECT EITHER HOUR OR MINUTE SPEEDS FROM A FRONT-PANEL KNOB, OR BY USE OF A REMOTE SWITCH.

THE OUTPUT SHAFT OF THE GEAR HEAD POWERS THE CHART DRIVE TRANSMISSION, WHICH MAY BE EITHER A SINGLE-SPEED OR MULTIPLE-SPEED TYPE. IN THE MULTIPLE TYPE, SPEED IS VARIED BY A UNIQUE SYSTEM OF CAM-OPERATED GEARS AND OVER-RUNNING CLUTCHES. CHART FEED RATES ARE MANUALLY SELECTED BY THE FEED-RATE SELECTOR LOCATED ON THE FRONT PANEL. THE OUTPUT SHAFT OF THE TRANSMISSION IS ALWAYS ENERGIZED AND THEREFORE "MESH-TIME" IS NEGLIGIBLE -- EVEN AT SLOW SPEEDS.

CHART FEED RATES HIGHER THAN 12-INCHES PER MINUTE ARE OBTAINED BY THE ADDITION OF A SECOND-SPEED ATTACHEMENT — CONSISTING OF A SEPARATE SYNCHRONOUS MOTOR AND SPECIAL HIGH-SPEED TRANSMISSION. THIS ATTACHMENT IS ELECTRICALLY ACTUATED BY A SPEED CONTROL KNOB ON THE FRONT PANEL OF THE INSTRUMENT, OR THROUGH THE USE OF AN EXTERNAL REMOTE SWITCH. THE MAXIMUM CHART FEED RATE OBTAINABLE WITH THIS ATTACHMENT IS 6-INCHES PER SECOND OR 30-FEET OF CHART PER MINUTE.

THUS FAR, WE HAVE DISCUSSED ONLY THOSE COMPONENTS OF THE CHART-DRIVING MECHANISM WHICH ARE PHYSICALLY POSITIONED AT THE REAR OF THE RECORDER CHASSIS. SINCE THE CHART TRANSPORT ASSEMBLY IS FOUND ON THE FRONT OF THE CHASSIS, A SPECIAL DRIVE COUPLING IS EMPLOYED. THE DRIVING MECHANISM IS COUPLED TO THE CHART TRANSPORT BY A CHAIN AND SPROCKET ARRANGEMENT THAT MAINTAINS CONSTANT SPEED AND ACCURATE TIMING THROUGHOUT THE SYSTEM.

A PRECISION GEAR TRAIN IN THE TRANSPORT ASSEMBLY UNWINDS THE CHART PAPER FROM A SUPPLY ROLL, PROPELS IT OVER A DRIVE ROLLER AND REWINDS IT ON A REROLL ARBOR. THE DRIVE ROLLER HAS A NUMBER OF FORMED PINS AT EACH END WHICH ENGAGE MARGINAL PERFORATIONS IN THE PAPER AND FEEDS THE CHART UNDER THE WRITING ELEMENT SMOOTHLY AND AT A CONSTANT RATE. A TIME-SET KNOB IS ALSO PROVIDED ON THE RIGHT END OF THE DRIVE ROLLER FOR MANUALLY ADVANCING THE CHART PAPER AND SETTING IT TO TIME. IN ADDITION, AN OVER-RUNNING CLUTCH IN THE REROLL ASSEMBLY MAINTAINS PROPER TENSION ON THE CHART PAPER AT ALL TIMES.

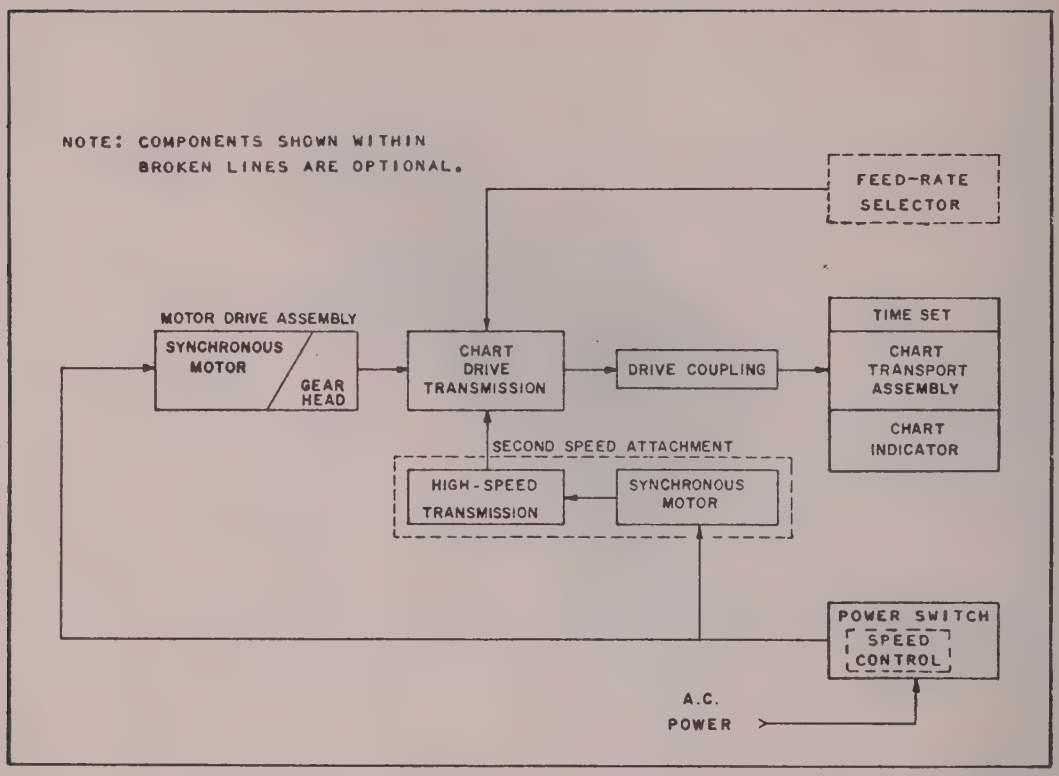


FIGURE C2. SIMPLIFIED BLOCK DIAGRAM OF CHART DRIVE SYSTEM.

THE TRANSPORT ASSEMBLY ON ALL SERIES "S" CHART DRIVES INCORPORATES A CHART-SUPPLY INDICATOR. THIS SMALL GAGE TELLS THE OPERATOR AT A GLANCE THE AMOUNT OF CHART PAPER REMAINING ON THE SUPPLY ROLL. RELOADING IS MADE EASY BY A SPECIAL TILT-DOWN TRANSPORT WHICH IS AN EXCLUSIVE FEATURE ON ALL LABGRAPH RECORDERS.

LABGRAPH CHART DRIVES ARE EQUIPPED WITH A SPECIAL INTERNAL CLUTCH SO THAT THE CHART MAY BE DRIVEN FROM AN EXTERNAL SOURCE. WHEN THE EXTERNAL SOURCE CAN REVERSE DIRECTION, A SEPARATE BACK-UP CLUTCH MUST BE INSTALLED IN THE SYSTEM. THE INTERNAL MECHANISM MAY ALSO BE USED TO DRIVE AN EXTERNAL DEVICE; IT IS NOT, HOWEVER, SUITABLE FOR TRANSMITTING A GREAT DEGREE OF TORQUE, AND WILL THEREFORE OPERATE SYNCHRONOUSLY ONLY UNDER LIGHT LOADS.

AN ACCESS HOLE IS PROVIDED ON THE SIDE OF THE LABGRAPH CASE FOR EXTERNAL CHART-DRIVE COUPLING. THE DRIVE SHAFT AT THIS POINT HAS A BALL AND CROSS-PIN FITTING. EXTERNAL DEVICES SHOULD BE ATTACHED TO THE FITTING BY MEANS OF A FLEXIBLE COUPLER (CONSULT FACTORY FOR ADDITIONAL DETAILS).

SPECIFICATIONS

GENERAL SPECIFICATIONS

INSTRUMENT TYPE:

EVENT.....RECTILINEAR
ACTUATION.....ELECTROMAGNETS

RECORD CHARACTERISTICS:

CHANNEL SPACING (APPROX.)..1/4"
ELEMENT DISPLACEMENT.....1/10"

OPERATING LIMITS:

RATED OPERATING VOLTAGE....±15%
AMBIENT TEMP.....+20 TO +120°F

RESPONSE:

REPETITION(MAX.)..10 PULSES/SEC.
PULSE WIDTH(MIN.).....15 MS.

DIELECTRIC RATING:
(ONE MINUTE TEST)

TERMINALS TO CHASSIS...1,500V AC

STEP-DOWN TRANSFORMER:
(FOR SWITCH-TYPE ONLY)

PRI.....120 OR 240V(50-60 CPS)
SEC.....24V(50-60 CPS)

ELECTROMAGNET RATINGS

Electromagnet Voltage Rating	Coil Style	Current (MA)	DC Resistance (ohms)	Power Consumption (Watts)
Direct Current				
2V	N	570	3.5	1.1
4V	K	286	14	1.1
6V	J	231	26	1.4
8V	G	131	61	1.0
10V	F	99	101	1.0
12V	F	119	101	1.4
14V	E	90	156	1.3
16V	D	67	238	1.1
18V	D	76	238	1.4
24V	C	65	372	1.6
28V	B	42	666	1.2
32V	A	29	1092	0.9
48V	T	29	1650	1.4
125V	T	31	1650①	3.9
250V	T	26	1650③	6.5
50-60 cps AC				
6V	N	447	3.5	1.6
12V	K	233	14	1.7
24V	G	103	61	1.5
120V④	G	103	61	1.5
120V	T	20	1650	1.5
240V④	G	103	61	1.5
240V	T	21	1650③	4.5

① Requires 3000-ohm series resistance. ② Requires 7000-ohm series resistance. ③ Requires 8000-ohm series resistance. ④ Used with external step-down transformer for 24V switch-type operation.

INK MODEL S620X

RECORDING MEDIA.....PAPER STRIP-CHART, 6" X 103'

METHOD OF WRITING.....PEN AND INK.

INK SUPPLY.....WELL CAPACITY 1-1/4 OZ.

EVENT PEN INDICATOR.....CHANNEL-NUMBERED SCALEPLATE

OPTIONAL FEATURES...5, 10, 15, OR 20 ACTIVE CHANNELS; CONNECTIONS (ISOLATED, COMMON, OR SWITCH); TOTALING COUNTERS.

INKLESS MODEL S620T

RECORDING MEDIA.....HEAT-AND PRESSURE-SENSITIVE STRIP CHART, 6" X 81"

METHOD OF WRITING.....ELECTRICALLY-HEATED STYLUSES

STYLUS INDICATOR.....CHANNEL-NUMBERED SCALEPLATE

ADJUSTMENTS.....ON-OFF HEAT SWITCH, HEAT CONTROL, STYLUS PRESSURE ADJUST.

POWER REQUIREMENTS (STYLUS HEAT).....40 VA AT 120 OR 240V AC, ±10%, 50-60 CPS.

OPTIONAL FEATURES.....10 OR 20 ACTIVE CHANNELS; CONNECTIONS (ISOLATED, COMMON, OR SWITCH); TOTALING COUNTERS; 12V-DC HEATING CIRCUIT.

CHART DRIVE SPECIFICATIONS

SYNCHRONOUS MOTOR

Time Base.....Power Line Frequency
Voltage Source.....120 or 240* V AC (±10%)
Source Frequency.....50 or 60 cps
Power Consumption.....20 to 60 Volt-Amps
Protection Feature** .....Rear-Panel Fuse

TRANSMISSION (optional)

Single Speed.....Hr., Min., or Sec.
Multi-Speeds..(Hr, Min, or Sec) (Hr-Min) or (Hr-Min-Sec.)
External Drive Provision**..Ball and Cross-pin Coupling

CHART TRANSPORT

"ON" Indicator** .....Front-Panel Lamp
Pin Roller.....Dual-ended Drive
Chart Supply Gage.....Front Panel Indicator
Chart Take-Up.....Automatically Regulated Reroll
Writing Table** .....5" Length with Tear Bar
Standard Speeds:
  Inches/Unit Time.....0.75, 1.5, 3.0, 6.0, 12
  MM/Unit Time..... (See separate table).

PANEL CONTROLS (optional)

Power (On-Off).....2-Pos. Switch
Electric Speed Control.....3- or 4-Pos. Switch
Feed-rate Selector.....5-Pos. Mechanical Type
Manual Time-Set.....Drive Roller Knob

CHART CHARACTERISTICS

Ink Paper.....6" X 103' (15mm X 31m)
Thermal Paper.....6" X 81' (15mm X 25m)
Printed Coordinates.....4.5" Span (Rectilinear)

SERVICE FEATURES

Chart Loading.....Tilt-Down Transport
Paper Tension.....Adjustable Reroll Clutch
Lift-off Transport**.....Direct Gear-Mesh Coupling
Transport Removal.....Push-Button Release†

* May require external transformer. ** LabGRAPH only.
† PanelGRAPH only.

SERIES "S" CHART DRIVES

Drive Style No.	Chart Feed Rate	Number of Speeds Available
200	(Optional) 3/4, 1-1/2, 3, 6, or 12 inches per hour	1
203 π	3/4, 1-1/2, 3, 6, and 12 inches per hour	5
206	(Optional) 3/4, 1-1/2, 3, 6, or 12 inches per minute	1
209 π	3/4, 1-1/2, 3, 6, and 12 inches per minute	5
212	(Optional) 3/4, 1-1/2, 3, or 6 inches per second	1
215 π	3/4, 1-1/2, 3, and 6 inches per second	4
218*	(Optional) 3/4, 1-1/2, 3, 6, or 12 inches per hour and minute	2
221π*	3/4, 1-1/2, 3, 6, and 12 inches per hour and minute	10
224	3/4, 1-1/2, 3, or 6 inches per hour, minute and second (Optional)	3
227π*	3/4, 1-1/2, 3, 6, and 12 inches per hour, minute and second.↯	14
232π*	3/4, 1-1/2, 3, 6, and 12 inches per minute and second.↯	9
234π*	3/4, 1-1/2, 3, 6, and 12 inches per hour and second.↯	9
π * ↯	Includes Feed-Rate Selector. Includes Electric Speed Control. Maximum Speed: 6" per second.	

NOTE: See Standard Chart Speeds table.

STANDARD CHART SPEEDS*

English units

drive no.	type	inches/hr	inches/min	inches/sec
227	14-speed, dial select	¾, 1½, 3, 6 and 12	¾, 1½, 3, 6 and 12	¾, 1½, 3 and 6
221	10-speed, dial select	¾, 1½, 3, 6 and 12	¾, 1½, 3, 6 and 12	—
232	9-speed, dial select	—	¾, 1½, 3, 6 and 12	¾, 1½, 3 and 6
234	9-speed, dial select	¾, 1½, 3, 6 and 12	—	¾, 1½, 3 and 6
209	5-speed, dial select	—	¾, 1½, 3, 6 and 12	—
203	5-speed, dial select	¾, 1½, 3, 6 and 12	—	—
215	4-speed, dial select	—	—	¾, 1½, 3 and 6
218	2-speed, dial select	¾, 1½, 3, 6 or 12	¾, 1½, 3, 6 or 12	—
206	1-speed	—	¾, 1½, 3, 6 or 12	—
200	1-speed	¾, 1½, 3, 6 or 12	—	—
236	Phantom Lab Graph	One revolution of external coupling shaft moves chart three inches.		

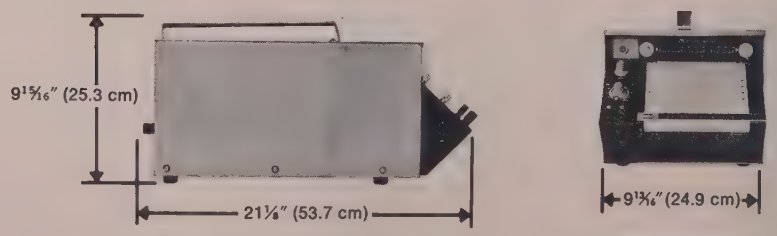
***Note:** An alternate standard inch speed is available. To determine speeds, multiply values in the above table by ⅔ (Example: ¾, 1½, 3, 6 and 12 inches become ½, 1, 2, 4, and 8 inches.

Metric units

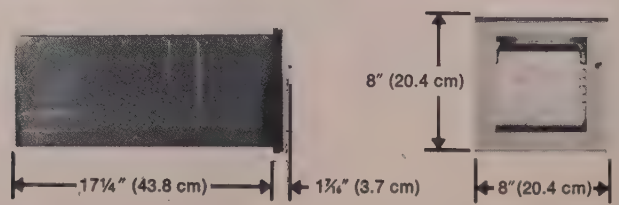
drive no.	type	mm/hr	mm/min	mm/sec
227	14-speed, dial select	12.5, 25, 50, 100 and 200	12.5, 25, 50, 100 and 200	12.5, 25, 50, 100 and 200
221	10-speed, dial select	12.5, 25, 50, 100 and 200	12.5, 25, 50, 100 and 200	—
232	9-speed, dial select	—	12.5, 25, 50, 100 and 200	12.5, 25, 50, 100 and 200
234	9-speed, dial select	12.5, 25, 50, 100 and 200	—	12.5, 25, 50, 100 and 200
209	5-speed, dial select	—	12.5, 25, 50, 100 and 200	—
203	5-speed, dial select	12.5, 25, 50, 100 and 200	—	—
215	4-speed, dial select	—	—	12.5, 25, 50, 100 and 200
218	2-speed, dial select	12.5, 25, 50, 100 or 200	12.5, 25, 50, 100 or 200	—
206	1-speed	—	12.5, 25, 50, 100 or 200	—
200	1-speed	12.5, 25, 50, 100 or 200	—	—
236	Phantom Lab Graph	One revolution of external coupling shaft moves chart 75 mm.		

CASE CONFIGURATIONS

Lab Graph (Portable)



Panel Graph (Flush)



SECTION D
MAINTENANCE INSTRUCTIONS

GENERAL

EventGraph recorders are of sturdy construction and are designed for long trouble-free operation. Nevertheless, they should receive the care afforded any precision piece of equipment. In the few cases where trouble may occur, it is recommended that the entire instrument be returned to the factory, rather than to attempt any major repairs in the field. Should adjustment or minor service become necessary in the field, refer to the following procedures.

> WARNING: Recorders connected to electrical circuits may be hazardous. To prevent accidental shock, always remove power from the instrument before disassembling or servicing.

ROUTINE MAINTENANCE

INKWELL REMOVAL (Model S620X)

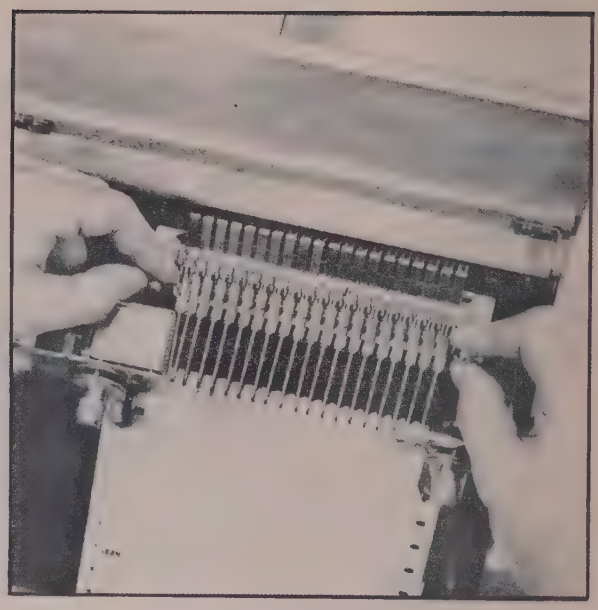
The inking system of the EventGraph is so designed that any pen element requiring attention may be removed or replaced individually; or, the entire inkwell and pen assembly may be removed or replaced in one operation. When replacing the inkwell, always make certain that the metal spring on each end of the well fits properly inside the mounting bracket. During operation, the inkwell should be all the way down in its mounting bracket and the tails on the pen elements must engage the flat, finger-like, arms that project from each electromagnet. It is recommended that once per week, or every two weeks, the inkwell and pen elements be thoroughly cleaned.

To remove the inkwell, proceed with the following steps:

(1) In PanelGRAPH recorders, slide chassis out to service position, raise scaleplate assembly and lower chart transport; for LabGRAPH models, raise case lid, lift out scaleplate, and lower chart transport.

(2) Remove entire inkwell in PanelGRAPH by using lifter knobs; in LabGRAPH, grasp lifter knobs, slightly raise inkwell from mounting bracket, then remove assembly by shifting it to right and lifting upward.

FLUSH MODELS



PORTABLE MODELS

FIGURE D1. INKWELL REMOVAL PROCEDURES (MODEL S620X).

THE FOLLOWING RECOMMENDED METHOD OF CLEANING WILL ENABLE THE USER TO WASH BOTH INKWELL AND PEN ELEMENTS IN THE SAME OPERATION. IF A PEN POINT BECOMES CLOGGED, IT MAY BE RE-OPENED BY USING THE PEN-POINT CLEANER SUPPLIED. WORK THE CLEANER WIRE IN AND OUT OF THE PEN ELEMENT AND FLUSH THE ELEMENT WITH CLEAR WATER.

CAUTION: DO NOT ATTEMPT TO REMOVE THE SEALED INKWELL COVER.

CLEANING PROCEDURES (MODEL S620X)

(1) REMOVE INKWELL ASSEMBLY FROM INSTRUMENT.

(2) REMOVE PEN FROM ONE END OF INKWELL AND, HOLDING OTHER PENS IN POSITION, POUR OUT REMAINING INK THROUGH END HOLE.

(3) REPLACE END PEN IN INKWELL AND REMOVE PENS #12 AND #13 (IF USED).

(4) DIRECT A NARROW STREAM OF WATER INTO FILLER HOLE OF INKWELL. AS INKWELL FILLS, WATER WILL BE FORCED THROUGH THE PEN ELEMENTS. CONTINUE OPERATION UNTIL WATER COMING FROM PENS IS CLEAR.

(5) TO EMPTY WATER FROM INKWELL, REMOVE END PEN AND, HOLDING OTHER PENS IN POSITION, POUR OUT ALL WATER THROUGH END HOLE.

(6) FLUSH PENS #12 AND #13 UNDER A STREAM OF WATER AND REPLACE IN INKWELL.

(7) Remove water from all pens by positioning inkwell assembly so that pen points rest downward on an absorbent towel or blotter. It will take about 10 minutes for water to be drawn from the pens.

(8) Dry outside of inkwell and pen elements. Fill inkwell with fresh ink, prime pens, and install in recorder.

> CAUTION: Always remove pens and inkwell before subjecting the recorder to any handling that may spill ink.

CLEANING (Model S620T)

Cleaning activities for the writing system of the Series "S" heat writer are minimal. Check stylus tips and remove any obvious dirt, dust or paper that may have accumulated. If one stylus does not appear to deflect as fully as the others, dust or some other foreign body may be lodged in the pivot. Inspect and carefully remove any such obstruction. Low pressure vacuuming -- recommended for general cleaning of the recorder -- should, however, dislodge most types of dirt likely to collect in these areas.

ADJUSTMENTS (Model S620T)

All inkless recorders are carefully setup for standard operation before leaving the factory; however, certain field adjustments are made possible to satisfy unusual applications and individual preferences. In order to properly evaluate results of these adjustments, the chart should be running and styluses cycled so that both forward and lateral writing characteristics may be observed.

Heat Control ---- Temperature of the writing elements is made variable by a rheostat which is connected in series with the stylus-heating circuit. When the control is rotated in a clockwise direction, temperature of the styluses will increase and the recorded lines on the chart will become darker. To reduce stylus temperature, and consequently lighten the recorded lines, the control is rotated counterclockwise. It is recommended that this control remain near its maximum clockwise position for optimum line perception.

Stylus Pressure ---- Pressure of the styluses on the chart paper is made variable by the screwdriver adjustments shown on the assembly drawing. When stylus pressure is decreased, the recorded lines will appear wider; when pressure is increased, the lines will become narrower. This adjustment is pre-set at the factory and will not require field attention ---- unless the stylus mounting assembly has been removed from the chassis.

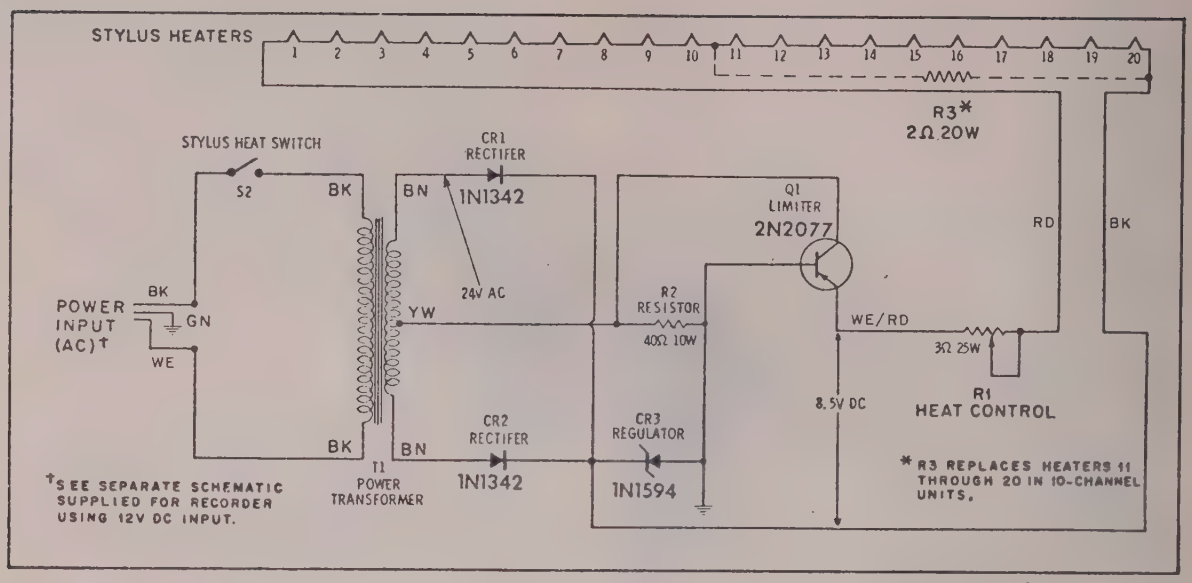


FIGURE D3. SCHEMATIC OF STYLUS HEAT CIRCUIT (MODEL S620T).

RECOMMENDED PROCEDURES FOR ADJUSTING PRESSURE ARE AS FOLLOWS: TURN ON THE INSTRUMENT AND SET THE HEAT CONTROL TO MINIMUM (FULLY COUNTERCLOCKWISE). LOOSEN THE TWO ADJUSTMENT SCREWS AND POSITION THE ENTIRE WRITING HEAD SO THAT ALL STYLUSES ARE PRODUCING FINE LINES ON THE CHART PAPER AND ARE PROPERLY RECORDING ALL LATERAL MOVEMENTS. ADVANCE THE HEAT CONTROL IF LINES ARE NOT CLEARLY VISIBLE. IF PRESSURE IS TOO LIGHT, THE STYLUSES WILL PRODUCE WIDE, BLURRY LINES. IF PRESSURE IS TOO HEAVY, THE STYLUSES WILL TEND TO DRAG AND NOT COMPLETELY RESPOND TO LATERAL MOVEMENTS.

CLEANING AND LUBRICATION

THE ENTIRE CHART DRIVE MECHANISM SHOULD BE CLEANED AT REGULAR INTERVALS DEPENDING UPON ENVIRONMENTAL CONDITIONS. A SOFT-BRISTLED BRUSH, VACUUM, OR LOW-PRESSURE AIR GUN MAY BE USED TO DISLODGE FOREIGN PARTICLES AND DIRT FROM THE CHART DRIVE MECHANISM. IF INK OR OTHER LIQUIDS ARE ACCIDENTALLY SPILLED ON THE CHART TRANSPORT ASSEMBLY, CLEAN THE UNIT IMMEDIATELY USING A SOFT CLOTH OR PAPER TOWEL MOISTENED WITH WATER.

ALL BEARINGS OF THE CHART DRIVE SYSTEM ARE SELF-LUBRICATING AND WILL NOT REQUIRE RELUBRICATION UNDER NORMAL OPERATING AND ENVIRONMENTAL CONDITIONS. IF BEARING LUBRICATION IS DEEMED NECESSARY USE EA 40 OIL. THIS OIL IS AVAILABLE FROM ESTERLINE ANGUS INSTRUMENT COMPANY IN ONE-OUNCE BOTTLES, AND IT IS FOR USE ON CHART DRIVES NORMALLY OPERATED AT TEMPERATURES OF 20° TO 100°F.

TEMPERATURES OUTSIDE OF THIS RANGE REQUIRE SPECIAL LUBRICATION (CONSULT FACTORY). DO NOT OIL RATCHETS AND PAWLS; THEY OPERATE BETTER WHEN DRY. WHEN OILING EXPOSED BEARING SURFACES IT IS WELL TO REMEMBER THAT TOO MUCH LUBRICATION IS AS BAD AS TOO LITTLE.

SYCHRONOUS CHART DRIVE MOTORS ARE LUBRICATED FOR LIFE. DO NOT ATTEMPT TO RELUBRICATE. AFTER 5 TO 10 YEARS OF SERVICE, A CHART DRIVE SHOULD BE RETURNED TO THE FACTORY FOR COMPLETE INSPECTION, CLEANING, AND OVERHAULING.

DISASSEMBLY

> WARNING: RECORDERS CONNECTED TO ELECTRICAL CIRCUITS MAY BE HAZARDOUS. TO PREVENT ACCIDENTAL SHOCK, ALWAYS REMOVE POWER FROM THE INSTRUMENT BEFORE DISASSEMBLING OR SERVICING.

CHART DRIVE (PANELGRAPH)

TO REMOVE THE CHART TRANSPORT ASSEMBLY FROM THE FRONT OF THE INSTRUMENT, PULL THE CHASSIS OUT TO THE SERVICE POSITION, RAISE THE SCALEPLATE, AND LOWER THE TRANSPORT ASSEMBLY TO THE CHART-LOADING POSITION. PUSH INWARD ON THE HEX-SHAPED BUTTON AT THE LEFT SIDE OF THE TRANSPORT AND TILT THE TRANSPORT SLIGHTLY UPWARD (FIG. D7). CAREFULLY LIFT UP ON TRANSPORT AND SWING OUT THE LEFT SIDE SLIGHTLY; LIFT UP THE RIGHT SIDE, DISCONNECT DRIVE CHAIN FROM FRONT SPROCKET, AND REMOVE TRANSPORT COMPLETELY. TO REASSEMBLE, REVERSE THE ABOVE PROCEDURES BEING CAREFUL NOT TO MISALIGN OR DAMAGE THE DRIVE CHAIN. FURTHER DISASSEMBLY OF THE CHART DRIVE IS NOT RECOMMENDED FOR FIELD MAINTENANCE.

CHART DRIVE (LABGRAPH)

TO REMOVE THE CHART TRANSPORT ASSEMBLY FROM THE INSTRUMENT, LOWER THE TRANSPORT ASSEMBLY TO THE CHART-LOADING POSITION. CAREFULLY LIFT STRAIGHT UP ON THE TRANSPORT AND REMOVE FROM FRONT OF RECORDER. TO REASSEMBLE, REVERSE THE ABOVE PROCEDURES BEING CAREFUL TO MESH THE GEARS PROPERLY WITHOUT FORCE. FURTHER DISASSEMBLY OF THE CHART DRIVE IS NOT RECOMMENDED FOR FIELD MAINTENANCE.

CHASSIS ACCESS

PANELGRAPH COMPONENTS ARE MADE ACCESSIBLE WHEN THE CHASSIS IS REMOVED FROM THE CASE. TO REMOVE THE CHASSIS, PRESS DOWN ON THE BAR ACROSS THE BOTTOM OF THE CHART TRANSPORT ASSEMBLY AND PULL THE CHASSIS OUT TO ITS SERVICE POSITION; THEN, RELEASE THE SMALL LEVER LOCATED ON THE RIGHT SIDE OF THE CHASSIS DIRECTLY BELOW THE CHART-DRIVE CHAIN, AND PULL THE CHASSIS COMPLETELY FROM THE CASE.

ACCESS TO CHASSIS COMPONENTS IN THE LABGRAPH CASE IS ACHIEVED BY REMOVAL OF A TOP SECTION OF THE CASE. TO DETACH THE SECTION, REMOVE 3 SCREWS FROM EACH SIDE OF THE LOWER BASEPLATE AND CAREFULLY LIFT THE SECTION UPWARD AND OFF THE CHASSIS.

ELECTROMAGNET ASSY. REMOVAL

IT IS NOT RECOMMENDED THAT THE ELECTROMAGNET ASSEMBLY BE REMOVED FROM THE INSTRUMENT IN THE FIELD. IF THIS OPERATION BECOMES NECESSARY FOR CLEANING OR MINOR REPAIRS, HOWEVER, PROCEED WITH THE FOLLOWING STEPS:

(1) IN MODEL S620X, REMOVE PEN-AND INKWELL ASSEMBLY; IN MODEL S620T, TURN OFF CHART DRIVE AND STYLUS-HEAT SWITCH.

(2) EXPOSE RECORDER CHASSIS BY FOLLOWING INSTRUCTIONS ELSEWHERE IN THIS SECTION.

(3) REMOVE TWO SCREWS FROM EACH SIDE OF CHASSIS. (SEE ASSEMBLY DRAWING).

(4) LIFT ASSEMBLY UP AND OUT OF CHASSIS. ASSEMBLY MAY BE TILTED BACK OR LAID TO ONE SIDE OF THE CHASSIS WITH WIRING HARNESS CONNECTED.

REPOSITION ASSEMBLY WITHIN CHASSIS AND REPLACE MOUNTING SCREWS THROUGH SLOTTED HOLES OF CHASSIS SIDEPLATES INTO END OF ELECTRO-MAGNET ASSEMBLY SUPPORT BARS -- DO NOT TIGHTEN SCREWS. MOVE THE ASSEMBLY FORWARD AND BACK UNTIL WRITING ELEMENTS ARE CORRECTLY POSITIONED ACROSS CENTER OF DRIVE ROLLER. WHEN CORRECTLY POSITIONED, TIGHTEN THE FOUR MOUNTING SCREWS. IF THE ELEMENTS ARE NOT TRACKING PROPERLY AFTER REASSEMBLY, PERFORM TRACKING RE-ALIGNMENT AS DIRECTED IN THIS SECTION.

TRACKING ADJUSTMENTS

IF THE RECORDING ELEMENTS ARE NOT TRACKING THEIR CHANNEL REFERENCE LINES ON THE CHART, THE STYLUSES OR PENS MAY BE SHIFTED BY LOOSENING THE ADJUSTMENT SCREWS SHOWN IN THE EVENTGRAPH ASSEMBLY DRAWING. ADJUSTMENTS ARE PROVIDED FOR REPOSITIONING THE INKWELL BRACKET AND COMB-STOP BAR, THE INKWELL MOUNTING PLATE AND THE ENTIRE ELECTO-MAGNET ASSEMBLY ON MODEL S620X; OR, THE ENTIRE WRITING HEAD ON MODEL S620T. WHEN MAKING THESE ADJUSTMENTS, ALWAYS MAINTAIN A SMALL GAP BETWEEN ARM AND ARMATURE AT THE REAR OF EACH ELECTRO-MAGNET -- AS ILLUSTRATED IN FIG. D2.

> NOTE: IN MODEL S620X, FULL LATERAL THROW OF CERTAIN PENS MAY BE RESTRICTED IF COMB BAR IS MOVED TOO FAR IN EITHER DIRECTION.

TO CHANGE THE WRITING POSITION OF AN INDIVIDUAL ELEMENT, CAREFULLY BEND THE PEN ELEMENT ITSELF UNTIL DESIRED ALIGNMENT IS ACHIEVED. WHEN PENS ARE REMOVED FOR CLEANING OR REPAIRS, SEE THAT THEY ARE INSTALLED IN THEIR ORIGINAL CHANNEL POSITIONS.

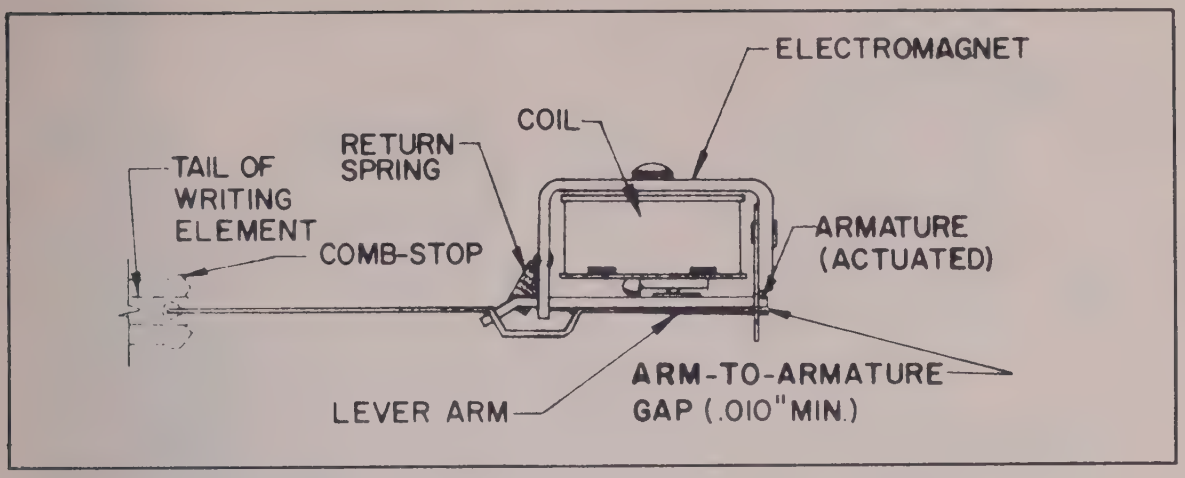


FIGURE D2. EVENT CHANNEL ACTUATING ASSEMBLY.

WARNING: ON MODEL S620T, AVOID DIRECT CONTACT WITH HEATED STYLUS TIPS WHEN MAKING ADJUSTMENTS.

CHART DRIVE ADJUSTMENTS

ALTHOUGH ALL ESTERLINE ANGUS RECORDERS ARE CAREFULLY ADJUSTED FOR STANDARD OPERATION BEFORE LEAVING THE FACTORY, CERTAIN FIELD ADJUSTMENTS ARE MADE POSSIBLE TO SATISFY SPECIAL APPLICATIONS AND AS A PREVENTIVE MAINTENANCE MEASURE.

CHART GUIDES -- THE PAPER GUIDES LOCATED ON TOP OF THE DRIVE ROLLER ARE PROPERLY ADJUSTED AT THE FACTORY AND WILL NOT NORMALLY REQUIRE ATTENTION IN THE FIELD. IF THE DRIVE HAS BEEN SUBJECTED TO ROUGH HANDLING OR HAS BEEN DISASSEMBLED IN THE FIELD, RE-ADJUSTMENT OF THE GUIDES MAY BE NECESSARY. THE CORRECT POSITION OF THE CHART GUIDES IS EVIDENT WHEN THERE IS NO TENDENCY OF THE PAPER TO BE DEPRESSED INTO THE GROOVES OF THE DRIVE ROLLER. THE TURNED-DOWN EDGE "A", FIG. D4, SHOULD FOLLOW THE CONTOUR OF THE DRIVE ROLLER, BUT ALLOW ENOUGH CLEARANCE SO THAT THERE IS NO DRAG ON THE PAPER. IT MAY BE NECESSARY TO LOOSEN SCREWS "B" (2 PER GUIDE), IN ORDER TO FACILITATE THIS ADJUSTMENT.

DRIVE ROLLER -- THE DRIVE ROLLER RETAINER, FIG. D4, EXERTS AN EXACT AMOUNT OF BEARING PRESSURE TO LIMIT ROLLER END-SHAKE; THUS FIXING THE POSITION OF THE ROLLER AND ELIMINATING LATERAL MOTION OF THE CHART PAPER. END-SHAKE IS VARIED BY LOOSENING OR TIGHTENING SCREW "X" (FIG. D4). A CORRECT SETTING IS OBTAINED WHEN THE SMALL GAP BETWEEN THE BRASS BEARING AND THE PLASTIC END PIECE OF THE ROLLER (POINT "P") REMAINS CONSTANT AS THE ROLLER DRUM IS WHIRLED BY HAND. IF THIS SCREW IS TOO LOOSE THE ROLLER WILL DRIFT BACK AND FORTH; AND, IF TOO TIGHT, THE ROLLER WILL NOT SPIN FREELY. ALTHOUGH THIS ADJUSTMENT HAS BEEN CORRECTLY SET AT THE FACTORY, READJUSTMENT MAY BE NECESSARY IF SCREW "X" HAS BEEN INADVERTENTLY MOVED.

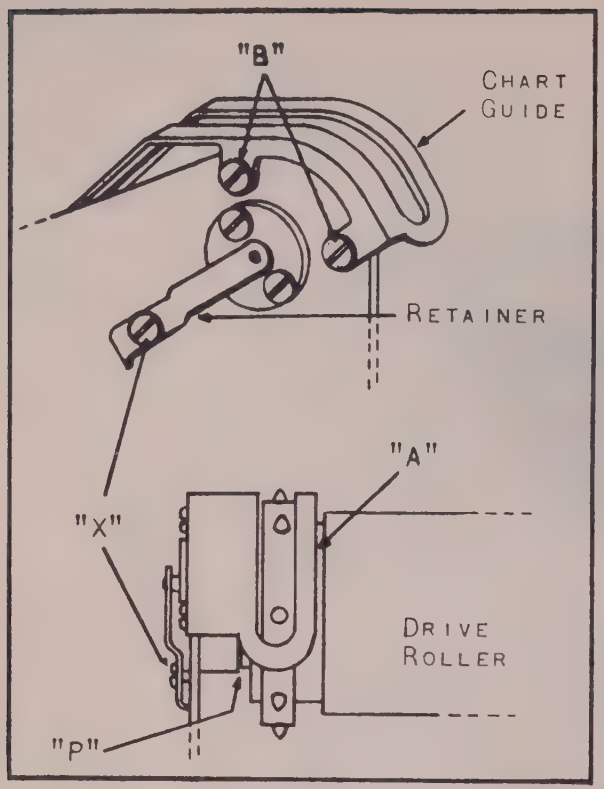


FIG. D4. CHART GUIDE AND RETAINER ADJUSTMENTS.

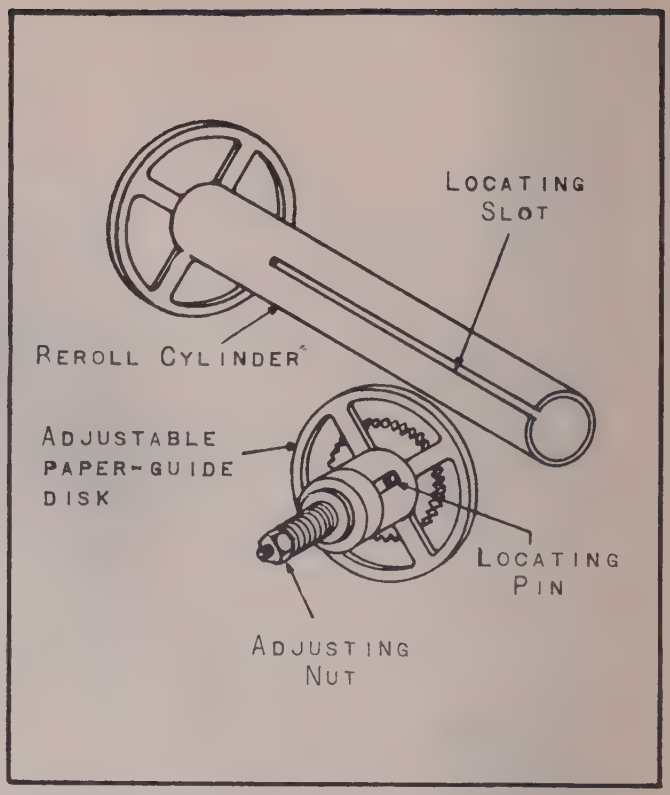


FIG. D5. REROLL CLUTCH ADJUSTMENT.

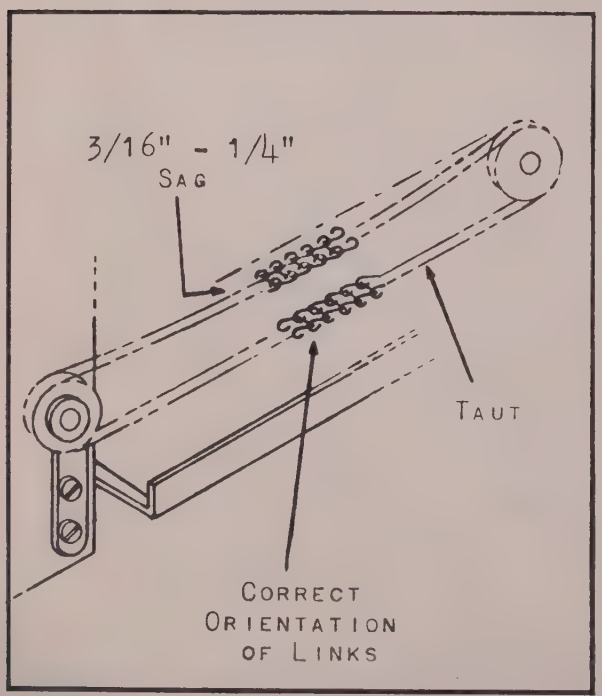


FIG. D6. DRIVE CHAIN POSITIONING.

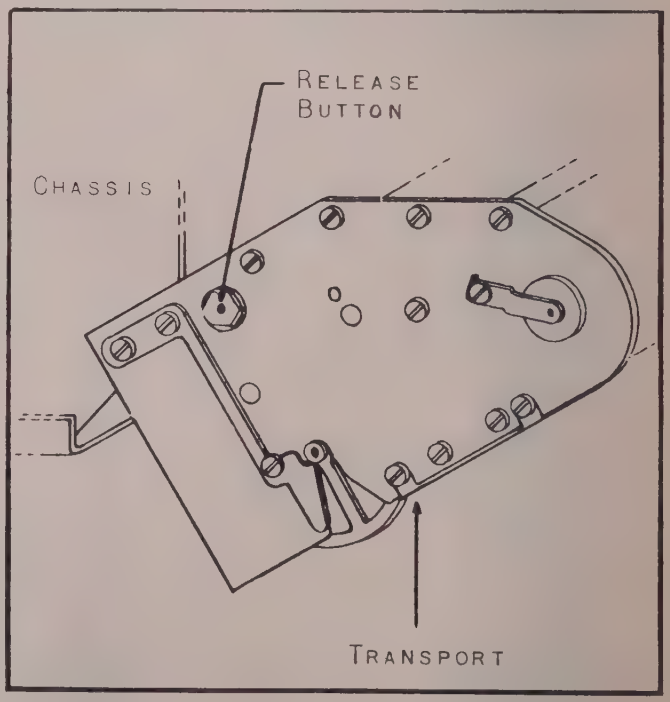


FIG. D7. CHART TRANSPORT REMOVAL. (PANELGRAPH).

REROLL CLUTCH -- FOR OPTIMUM CHART DRIVE OPERATION, THE REROLL SYSTEM MUST APPLY A REGULATED AMOUNT OF TENSION ON THE CHART PAPER AT ALL TIMES. TO SUPPLY THIS TENSION, THE REROLL CYLINDER CONTAINS A SMALL CLUTCH AS PART OF ITS REMOVABLE GEAR ASSEMBLY. CLUTCH TENSION IS ADJUSTED BY WITHDRAWING THIS ASSEMBLY FROM THE REROLL CYLINDER AND TURNING THE ADJUSTMENT NUT AS REQUIRED. SEE FIG. D5.

IF CLUTCH TENSION IS TOO GREAT, THE CHART PAPER MAY START TO WRINKLE AS IT LEAVES THE DRIVE ROLLER. IN EXTREME CASES, THE PAPER MAY EVEN TEAR OR SKIP PINS ON THE DRIVE ROLLER. IF THERE IS NOT ENOUGH TENSION, THE CHART PAPER MAY TEND TO SAG AND NOT WRAP PROPERLY ON THE REROLL CYLINDER. THESE CONDITIONS WILL NOT EXIST WHEN THE CLUTCH IS CORRECTLY ADJUSTED.

NOTE: DO NOT ATTEMPT TO ADJUST THE CLUTCH UNLESS REROLL TROUBLE HAS BEEN TRACED TO THIS POSSIBLE SOURCE.

DRIVE CHAIN -- THE CHAIN AND SPROCKET MECHANISM ON THE RIGHT SIDE OF THE INSTRUMENT CHASSIS MUST BE CORRECTLY INSTALLED FOR RELIABLE OPERATION OF THE CHART TRANSPORT. RECOMMENDED ORIENTATION AND TENSION OF THE CHAIN ARE SHOWN IN FIG. D6. NOTE DIRECTION OF CHAIN LINKS AND THE SLIGHT AMOUNT OF CHAIN SAG UNDER LOAD. CHAIN TENSION MAY BE ADJUSTED BY LOOSENING THE MOUNTING SCREWS OF THE TRANSMISSION COMPONENTS AND MOVING THEM BACKWARD OR FORWARD AS REQUIRED. THIS ADJUSTMENT WILL NORMALLY ENTAIL CONSIDERABLE DISASSEMBLY AND SHOULD NOT BE PERFORMED UNLESS ABSOLUTELY NECESSARY.

NOTE: DO NOT LUBRICATE THE CHART DRIVE CHAIN.

DIAL COUPLING

PROPER ALIGNMENT IS REQUIRED WHEN INSTALLING DIAL COUPLING MECHANISM ON MULTI-SPEED DRIVES. TO SYNCHRONIZE DIAL KNOB WITH TRANSMISSION GEARING, PROCEED WITH THE FOLLOWING ADJUSTMENT STEPS:

1) PLACE CONTROL DIAL KNOB ON CONTROL SHAFT BY ALIGNING SET SCREW WITH FLAT ON SHAFT.

2) ADJUST KNOB LATERALLY ON SHAFT, SO KNOB AND SHAFT ROTATE FREELY AND DETENT PIN MAKES FIRM CONTACT WITH DETENTS IN BACK OF KNOB FLANGE, TIGHTEN SET SCREW.

3) WITH BOTH TRANSMISSION CAM AND CONTROL KNOB SET ON 1.5 SPEED, PLACE COUPLING ON TRANSMISSION CONTROL SHAFT, THEN PLACE END OF CABLE IN "D" HOLE OF COUPLING.

4) POSITION COUPLING WITHIN APPROX. 1/32 OF TRANSMISSION AND TIGHTEN SET SCREWS.

NOTE: TO PREVENT LOOSENING, APPLY CEMENT OR LACQUER TO END OF SETSCREW.

TROUBLESHOOTING

RECORDING SYSTEM TROUBLESHOOTING GUIDE
(MODEL S620X INK WRITER)

TROUBLE SYMPTOM	PROBABLE CAUSE	SUGGESTED REMEDY
System inoperative (no deflection).	Source failure or faulty connection.	Check input signal and all connections.
	Open or defective event recording circuit.	Test and replace faulty component(s).
All pens displaced too far to right or left.	Pen actuating levers not properly aligned.	Adjust comb bar (refer to ADJUSTMENTS).
Only some pens displaced too far to right or left.	Bent pen tips.	Carefully bend each displaced pen until proper tracking is achieved (refer to ADJUSTMENTS).
Buzzing electromagnet.	Foreign object obstructing armature.	Remove foreign object so arm moves freely.
All pens fail to record.	Dirty pen points or contaminated ink.	Clean inking system (refer to CLEANING PROCEDURES).
An individual pen fails to deflect.	Foreign material at pen pivot.	Clean pivot.
	Defective electromagnet circuit, or loss of event signal.	Replace electromagnet assembly (refer to DISASSEMBLY) or repair possible defective wiring.
	Pen element tails not properly engaging electromagnet arm.	Check and correct pen element installation.
Inking system inoperative.	Loss of prime or clogged pens.	Reprime or clean system (refer to CLEANING PROCEDURES).
Ink pen skips.	Restricted ink flow.	Clean pen or replace element (refer to CLEANING PROCEDURES).
	Pen element improperly installed.	Check pen element installation.
Ink trace spreads on chart paper.	Inferior ink or chart.	Use only recommended EA supplies.
	Dirty pen points or contaminated ink.	Clean inking system and refill with fresh ink (refer to CLEANING PROCEDURES).
Problem with chart paper.	Fault in drive mechanism.	See Chart Drive Troubleshooting Guide.

RECORDING SYSTEM TROUBLESHOOTING GUIDE
(MODEL S620T HEAT WRITER)

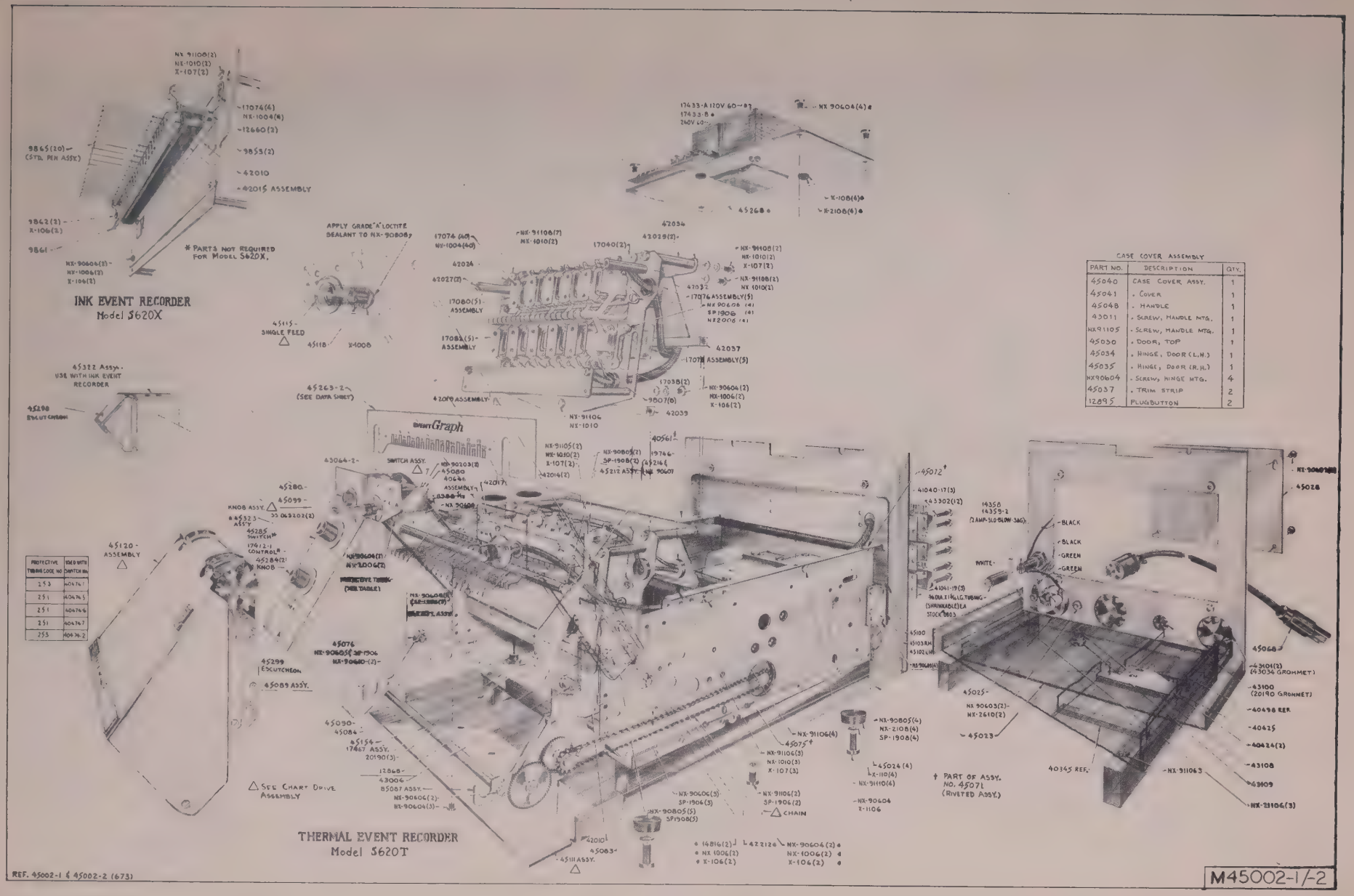
TROUBLE SYMPTOM	PROBABLE CAUSE	SUGGESTED REMEDY
System inoperative (no deflection).	Source failure or faulty connection.	Check input signal and all connections.
	Open or defective event recording circuit.	Test and replace faulty component(s).
Recorded lines on chart too light.	Stylus temperature too low.	Advance stylus-heat control (refer to ADJUSTMENTS).
	Stylus pressure too great.	Adjust stylus pressure (refer to ADJUSTMENTS).
	Chart speed changed from hour to minute feed.	Adjust stylus pressure or increase stylus heat (refer to ADJUSTMENTS).
Recorded lines on chart too heavy.	Stylus temperature too high.	Reduce stylus heat (refer to ADJUSTMENTS).
	Stylus pressure too light.	Adjust stylus pressure (refer to ADJUSTMENTS).
	Chart speed changed from minute to hour feed.	Adjust stylus pressure or decrease stylus heat (refer to ADJUSTMENTS).
Stylus tips drag and do not record lateral movements.	Stylus pressure too great.	Adjust stylus pressure (refer to ADJUSTMENTS).
Recorded lines are wide and blurry.	Stylus pressure too light.	Adjust stylus pressure. (refer to ADJUSTMENTS).
All styluses displaced too far to right or left.	Stylus actuating levers not properly aligned.	Adjust comb bar (refer to ADJUSTMENTS).
Only some styluses displaced too far to right or left.	Bent stylus tips.	Turn off stylus heat, allow tips to cool, and carefully bend each displaced stylus.
Buzzing electromagnet.	Foreign object obstructing armature.	Remove foreign object so arm moves freely.
All styluses fail to record.	Poor connection at connection head.	Repair connection.
	Defective stylus-heat circuit.	Repair power supply (see wiring diagram).
An individual stylus fails to deflect.	Foreign material at stylus pivot.	Clean pivot.
	Defective electromagnet circuit, or loss of event signal.	Replace electromagnet assembly (refer to DISASSEMBLY) or repair defective wiring.
Stylus tip burns; then opens.	Stylus shorted to metal roller and protective circuit inoperative.	Check zener diode CR3 in protective circuit of stylus power supply (see wiring diagram).
Leading edge of holes in chart paper tear.	Stylus pressure too great.	Adjust stylus pressure (refer to ADJUSTMENTS).
	Chart paper binding.	See Chart Drive Troubleshooting Guide.

CHART DRIVE TROUBLESHOOTING GUIDE

TROUBLE SYMPTOM	PROBABLE CAUSE	SUGGESTED REMEDY
Drive Inoperative.	Improper adjustment.	Reposition switch or dial (refer to CONTROLS).
	*Transport incorrectly installed (LabGRAPH).	See that transport gear engages chassis drive gear.
	Loss of power.	Check power source, fuse (LabGRAPH), wiring, switch and motor.
	Damaged transmission gear (LabGRAPH) caused by stalled transport (see * above).	Replace gear or assembly (Always see that transport gear meshes properly with chassis gear).
	Broken or disengaged drive chain.	Check chain on right-side of chassis.
Drive operates in certain feed rates but fails in others. (Multi-speed drives).	Defective switch.	Replace selector switch.
	Faulty Transmission.	Adjust or replace unit.
Chart does not run at correct speed.	Incorrect power source.	Check voltage and frequency (see Data Sheet).
	Defective drive (external coupling).	Check external drive source and coupling.
	Improper dial alignment (multi-speed only).	Adjust coupling (refer to ADJUSTMENTS).
Chart wrinkles as it leaves drive roller and/or skips roller pins.	Paper not rerolling properly.	Straighten chart on reroll cylinder.
	Excessive tension on chart.	Decrease reroll clutch tension (refer to ADJUSTMENTS).
	Chart guides misaligned.	Adjust chart guides (refer to ADJUSTMENTS).
Chart tends to sag and not wrap properly on reroll cylinder.	Insufficient tension on chart.	Increase reroll clutch tension (refer to ADJUSTMENTS).
Leading edge of holes in chart paper tear.	Chart paper binding.	See that supply roll turns freely and chart is correctly installed.
Noise from drive.	Loose drive chain.	Adjust chain (refer to ADJUSTMENTS).
	Loose or broken mounting hardware.	Tighten or replace hardware.
	Lack of bearing lubricant.	Follow instructions under CLEANING AND LUBRICATION.
	Normal wear of drive motor.	If objectionable, replace motor.
Excessive lateral movement of chart.	Too much end-shake in drive roller.	Adjust bearing pressure (refer to ADJUSTMENTS).

REPLACEMENT PARTS

Refer to the appropriate assembly drawing in this manual for parts identification. All parts for the recorder are available directly from Esterline Angus. When ordering parts, always give the part number and instrument serial number.


INK EVENT RECORDER
Model 5620X
* PARTS NOT REQUIRED FOR MODEL 5620X.
APPLY GRADE 'A' LOCTITE SEALANT TO NX-90808
45322 Assy. USE WITH INK EVENT RECORDER
45263-2 (SEE DATA SHEET)
THERMAL EVENT RECORDER
Model 5620T
CASE COVER ASSEMBLY
PART NO. | DESCRIPTION | QTY.
45040 | CASE COVER ASSY. | 1
45041 | . COVER | 1
45048 | . HANDLE | 1
43011 | . SCREW, HANDLE MTG. | 1
NX91105 | . SCREW, HANDLE MTG. | 1
45030 | . DOOR, TOP | 1
45034 | . HINGE, DOOR (L.H.) | 1
45035 | . HINGE, DOOR (R.H.) | 1
NX90604 | . SCREW, HINGE MTG. | 4
45037 | . TRIM STRIP | 2
12895 | PLUGBUTTON | 2
† PART OF ASSY. NO. 45071 (RIVETED ASSY.)
M45002-1/-2

REF. 45002-1 & 45002-2 (673)

FIGURE D8. PARTS DIAGRAM FOR LABGRAPH RECORDING SYSTEM.

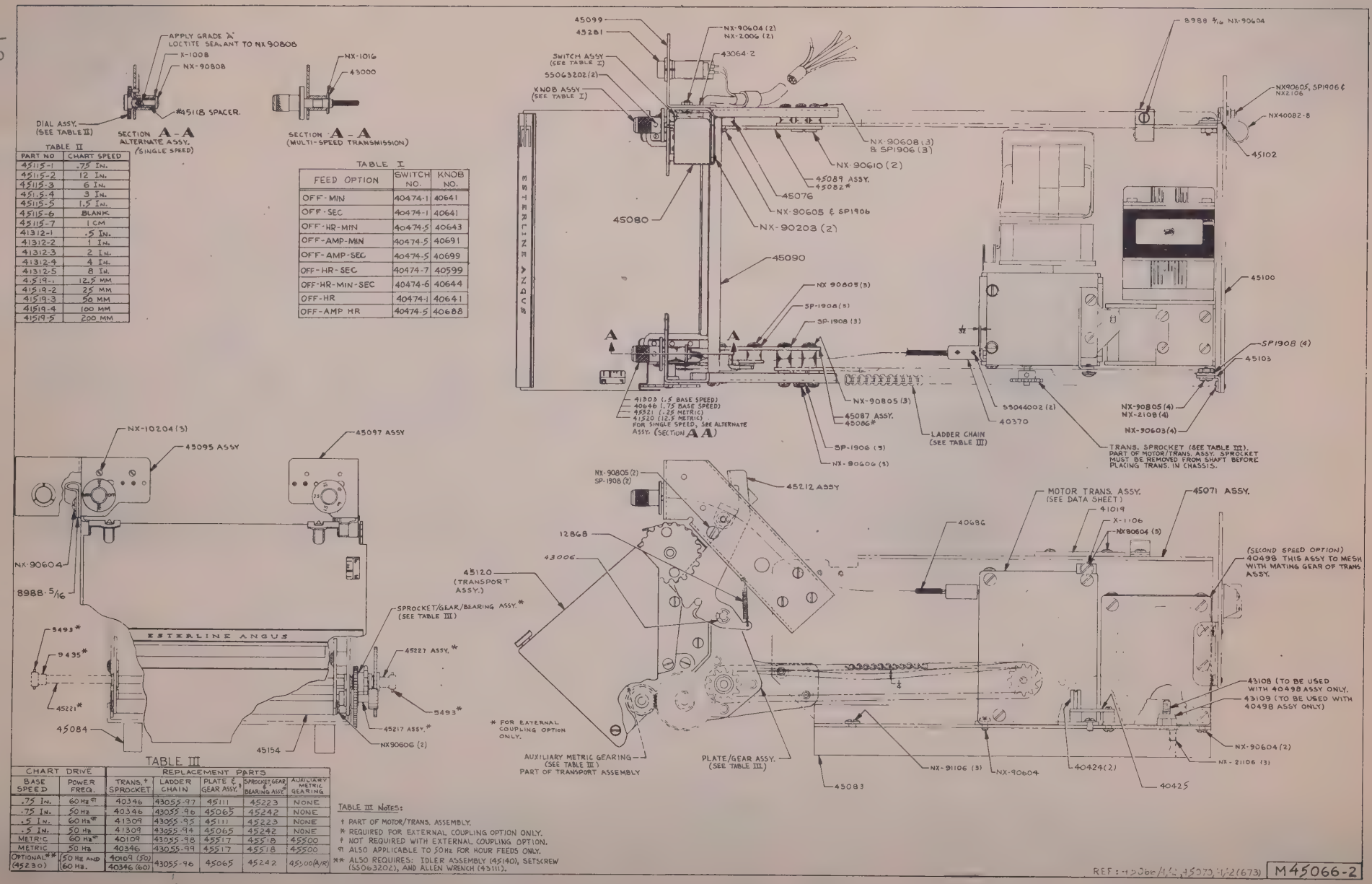


TABLE II

PART NO	CHART SPEED
45115-1	.75 IN.
45115-2	12 IN.
45115-3	6 IN.
45115-4	3 IN.
45115-5	1.5 IN.
45115-6	BLANK
45115-7	1 CM
41312-1	.5 IN.
41312-2	1 IN.
41312-3	2 IN.
41312-4	4 IN.
41312-5	8 IN.
41519-1	12.5 MM
41519-2	25 MM
41519-3	50 MM
41519-4	100 MM
41519-5	200 MM

TABLE I

FEED OPTION	SWITCH NO.	KNOB NO.
OFF-MIN	40474-1	40641
OFF-SEC	40474-1	40641
OFF-HR-MIN	40474-5	40643
OFF-AMP-MIN	40474-5	40691
OFF-AMP-SEC	40474-5	40699
OFF-HR-SEC	40474-7	40599
OFF-HR-MIN-SEC	40474-6	40644
OFF-HR	40474-1	40641
OFF-AMP HR	40474-5	40688

TABLE III

CHART DRIVE		REPLACEMENT PARTS				
BASE SPEED	POWER FREQ.	TRANS.† SPROCKET	LADDER CHAIN	PLATE & GEAR ASSY.†	SPROCKET, GEAR & BEARING ASSY*	AUXILIARY METRIC GEARING
.75 IN.	60 Hz¶	40346	43055-97	45111	45223	NONE
.75 IN.	50 Hz	40346	43055-96	45065	45242	NONE
.5 IN.	60 Hz¶	41309	43055-95	45111	45223	NONE
.5 IN.	50 Hz	41309	43055-94	45065	45242	NONE
METRIC	60 Hz¶	40109	43055-98	45517	45518	45500
METRIC	50 Hz	40346	43055-99	45517	45518	45500
OPTIONAL** (45230)	50 Hz AND 60 Hz.	40109 (50) 40346 (60)	43055-96	45065	45242	45500(A/R)

TABLE III NOTES:

† PART OF MOTOR/TRANS. ASSEMBLY.
* REQUIRED FOR EXTERNAL COUPLING OPTION ONLY.
† NOT REQUIRED WITH EXTERNAL COUPLING OPTION.
¶ ALSO APPLICABLE TO 50Hz FOR HOUR FEEDS ONLY.
** ALSO REQUIRES: IDLER ASSEMBLY (45140), SETSCREW (SS063202), AND ALLEN WRENCH (43111).

REF: 41066, 45073, 45072 (673) M45066-2

FIGURE D9. PARTS DIAGRAM FOR LABGRAPH CHART DRIVE SYSTEM.

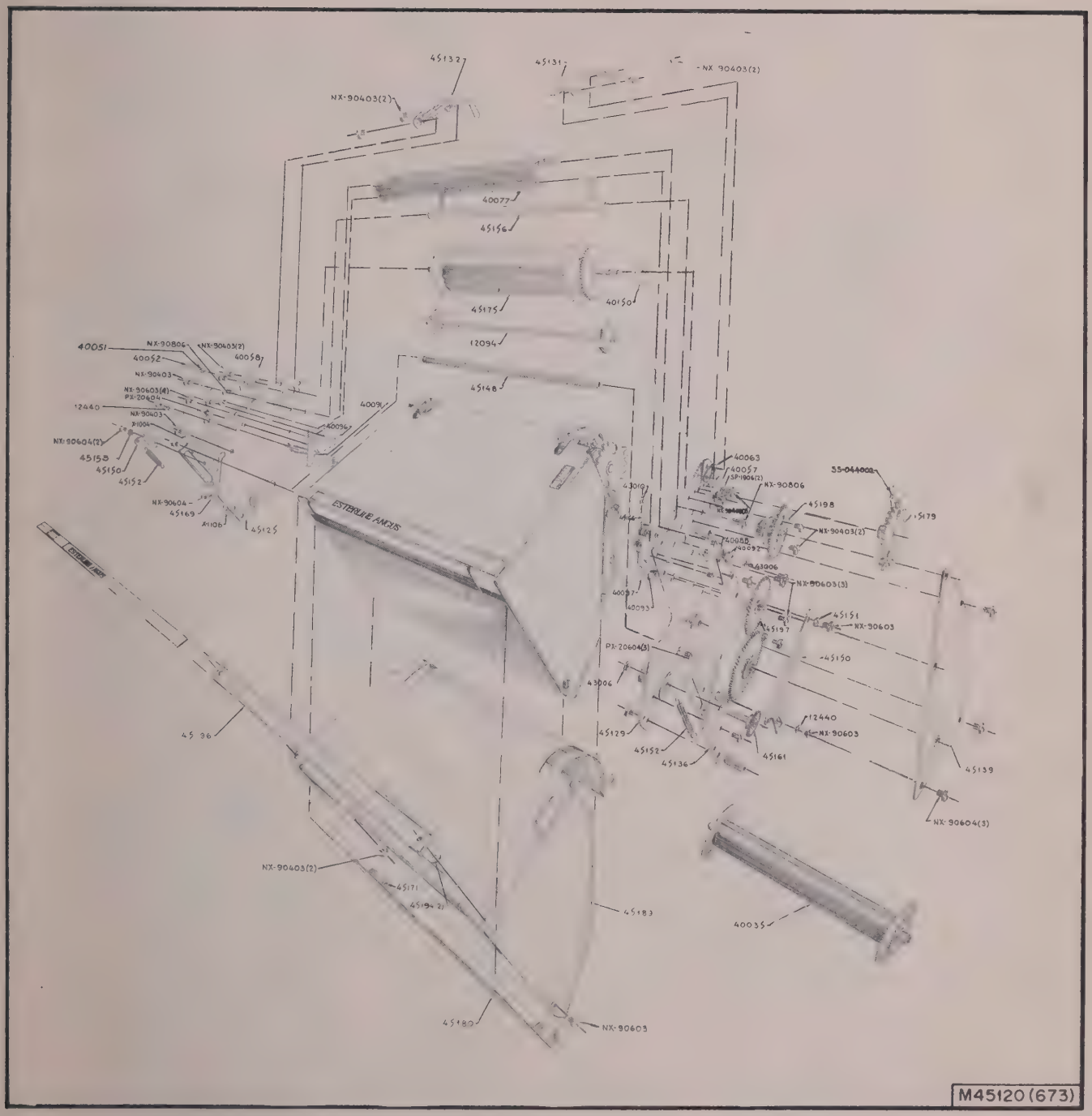


FIGURE D10. PARTS DIAGRAM FOR LABGRAPH CHART TRANSPORT.

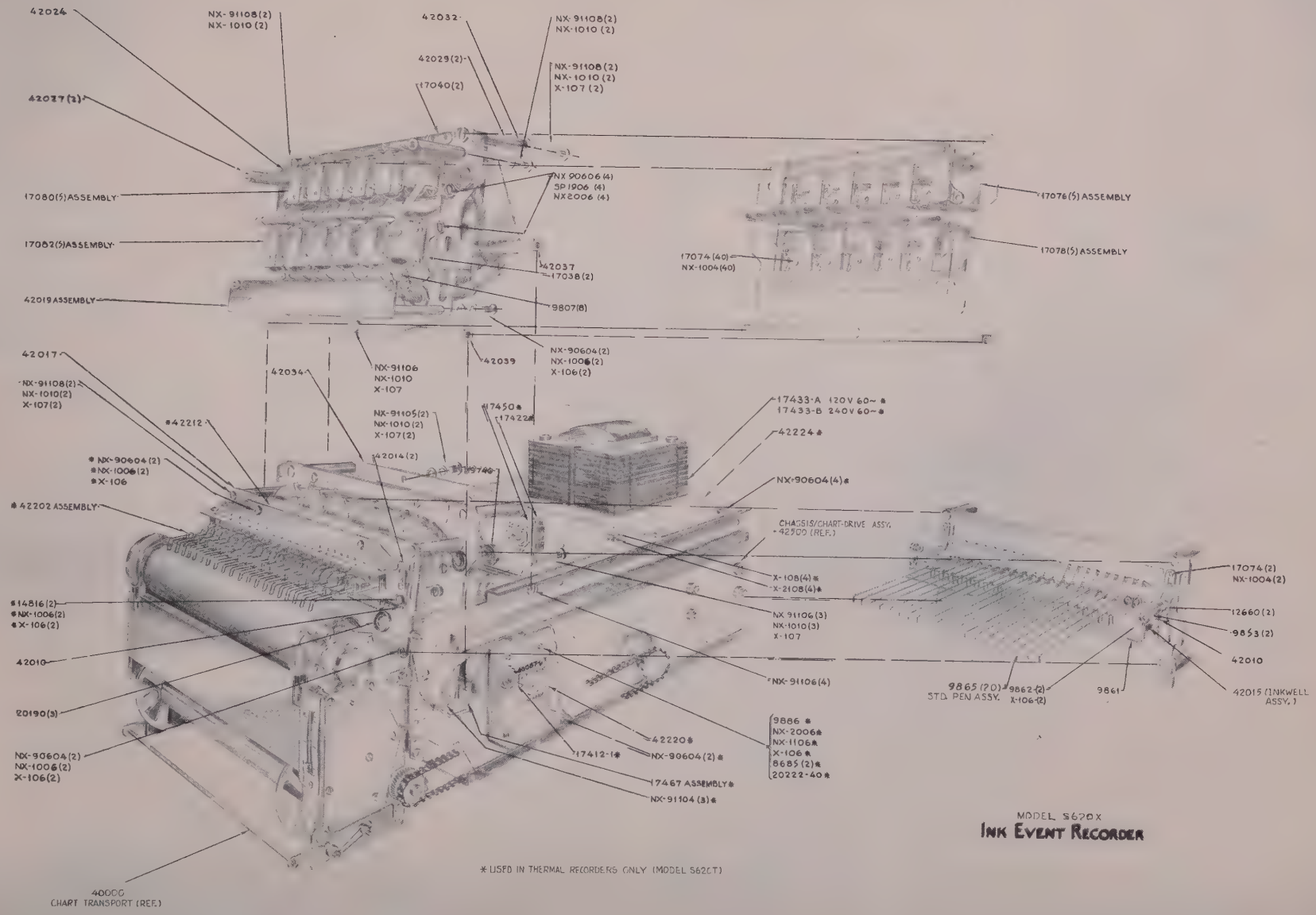
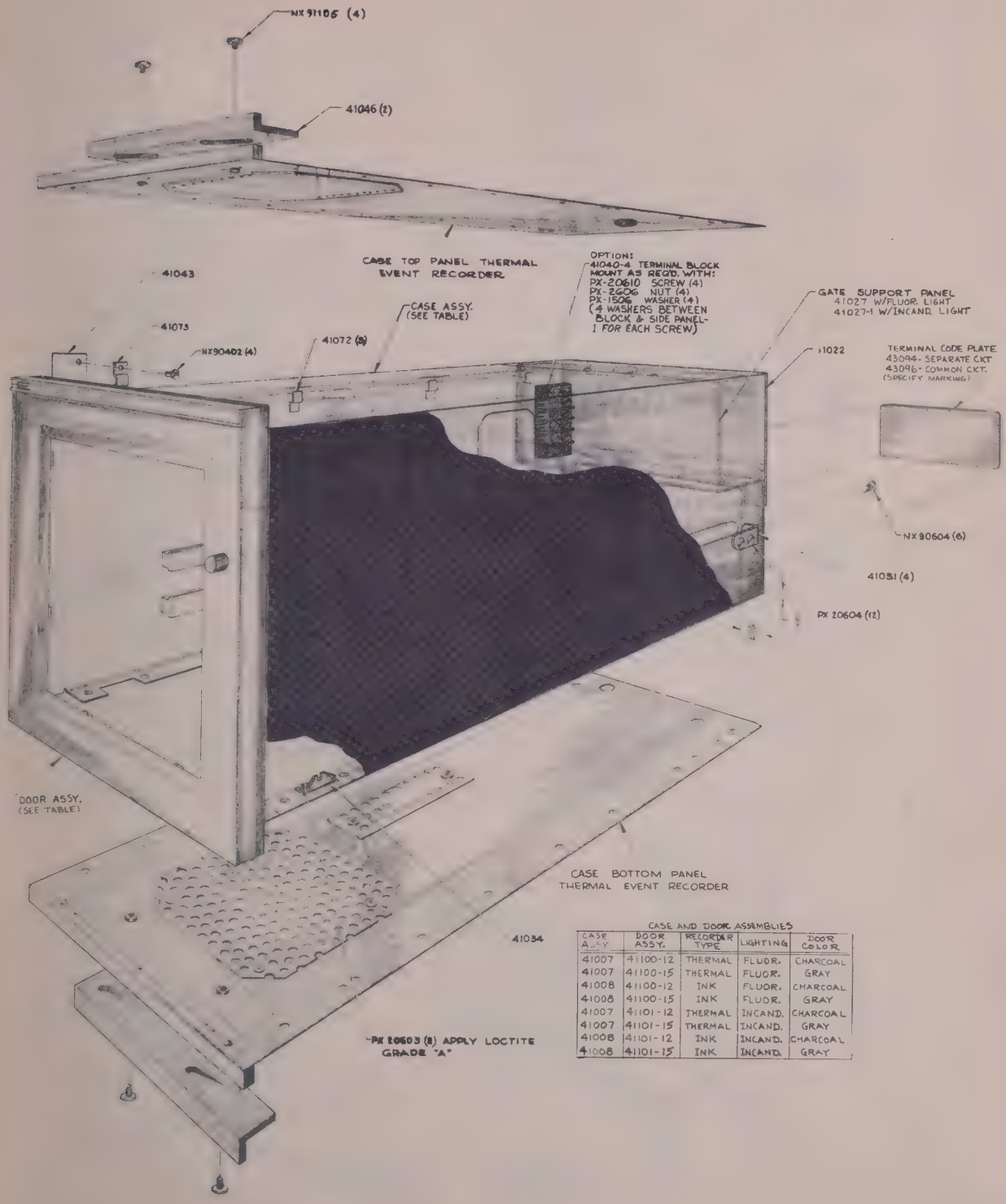


FIGURE D11. PARTS DIAGRAM FOR PANELGRAPH RECORDING SYSTEM.



CASE AND DOOR ASSEMBLIES

CASE ASSY	DOOR ASSY.	RECORDER TYPE	LIGHTING	DOOR COLOR
41007	41100-12	THERMAL	FLUOR.	CHARCOAL
41007	41100-15	THERMAL	FLUOR.	GRAY
41008	41100-12	INK	FLUOR.	CHARCOAL
41008	41100-15	INK	FLUOR.	GRAY
41007	41101-12	THERMAL	INCAND.	CHARCOAL
41007	41101-15	THERMAL	INCAND.	GRAY
41008	41101-12	INK	INCAND.	CHARCOAL
41008	41101-15	INK	INCAND.	GRAY

M41000(673)

FIGURE D12. PARTS DIAGRAM FOR PANELGRAPH CASE ASSEMBLY.

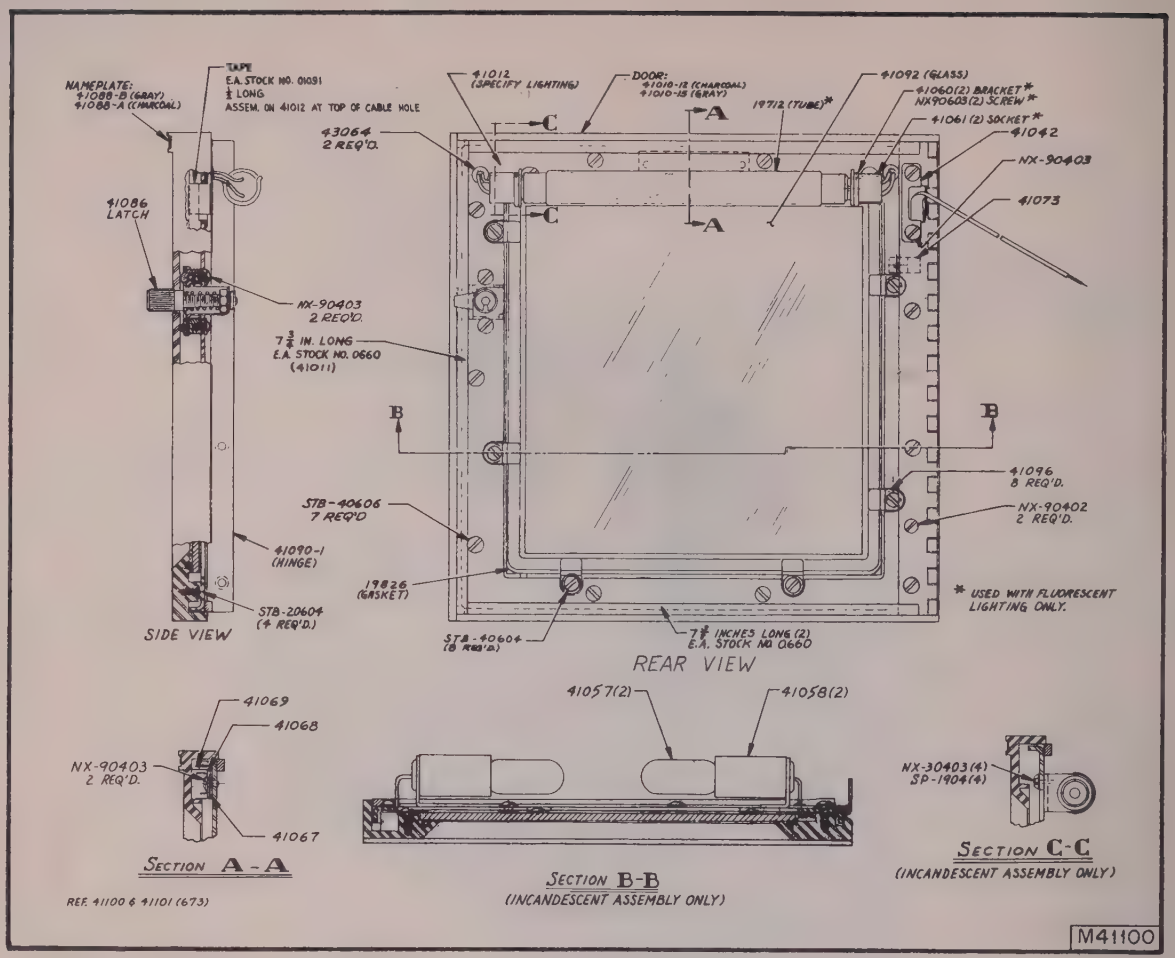


FIGURE D13. PARTS DIAGRAM FOR PANELGRAPH DOOR SUBASSEMBLY.

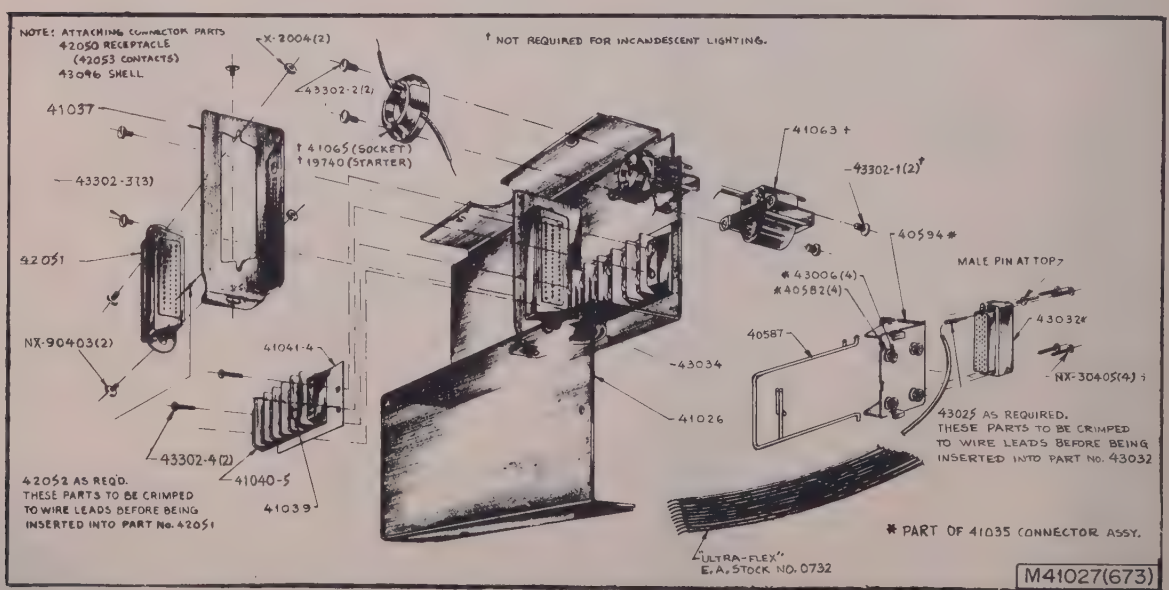


FIGURE D14. PARTS DIAGRAM FOR PANELGRAPH GATE SUPPORT PANEL SUBASSEMBLY.

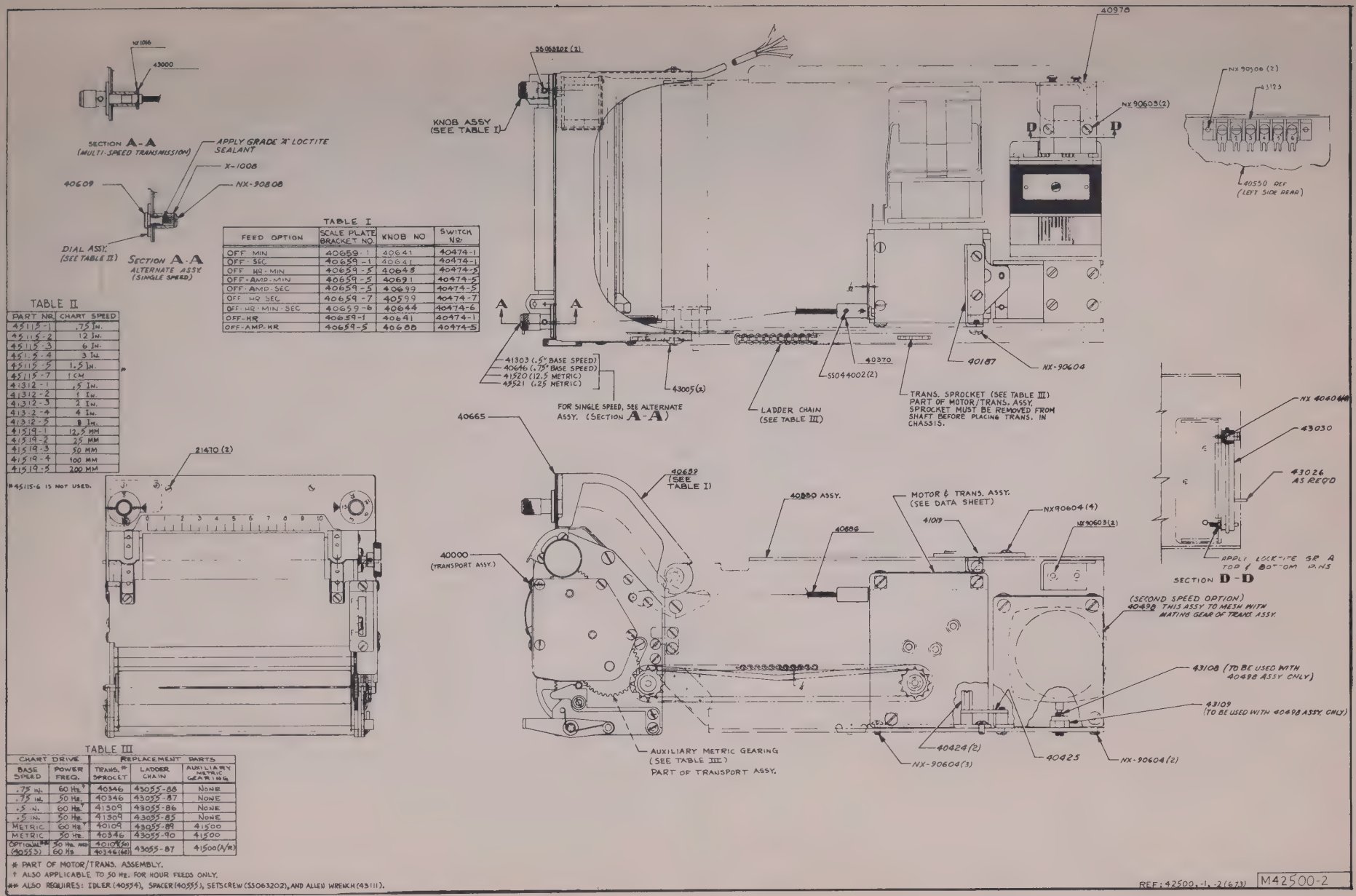


TABLE I

FEED OPTION	SCALE PLATE BRACKET NO	KNOB NO	SWITCH NO.
OFF MIN	40659-1	40641	40474-1
OFF SEC	40659-1	40641	40474-1
OFF HR-MIN	40659-5	40643	40474-5
OFF-AMP-MIN	40659-5	40691	40474-5
OFF-AMP-SEC	40659-5	40699	40474-5
OFF HR SEC	40659-7	40599	40474-7
OFF-HR-MIN-SEC	40659-6	40644	40474-6
OFF-HR	40659-1	40641	40474-1
OFF-AMP-HR	40659-5	40688	40474-5

TABLE II

PART NO.	CHART SPEED
45115-1	.75 IN.
45115-2	12 IN.
45115-3	6 IN.
45115-4	3 IN.
45115-5	1.5 IN.
45115-7	1 CM
41312-1	.5 IN.
41312-2	1 IN.
41312-3	2 IN.
41312-4	4 IN.
41312-5	8 IN.
41519-1	12.5 MM
41519-2	25 MM
41519-3	50 MM
41519-4	100 MM
41519-5	200 MM

* 45115-6 IS NOT USED.

TABLE III

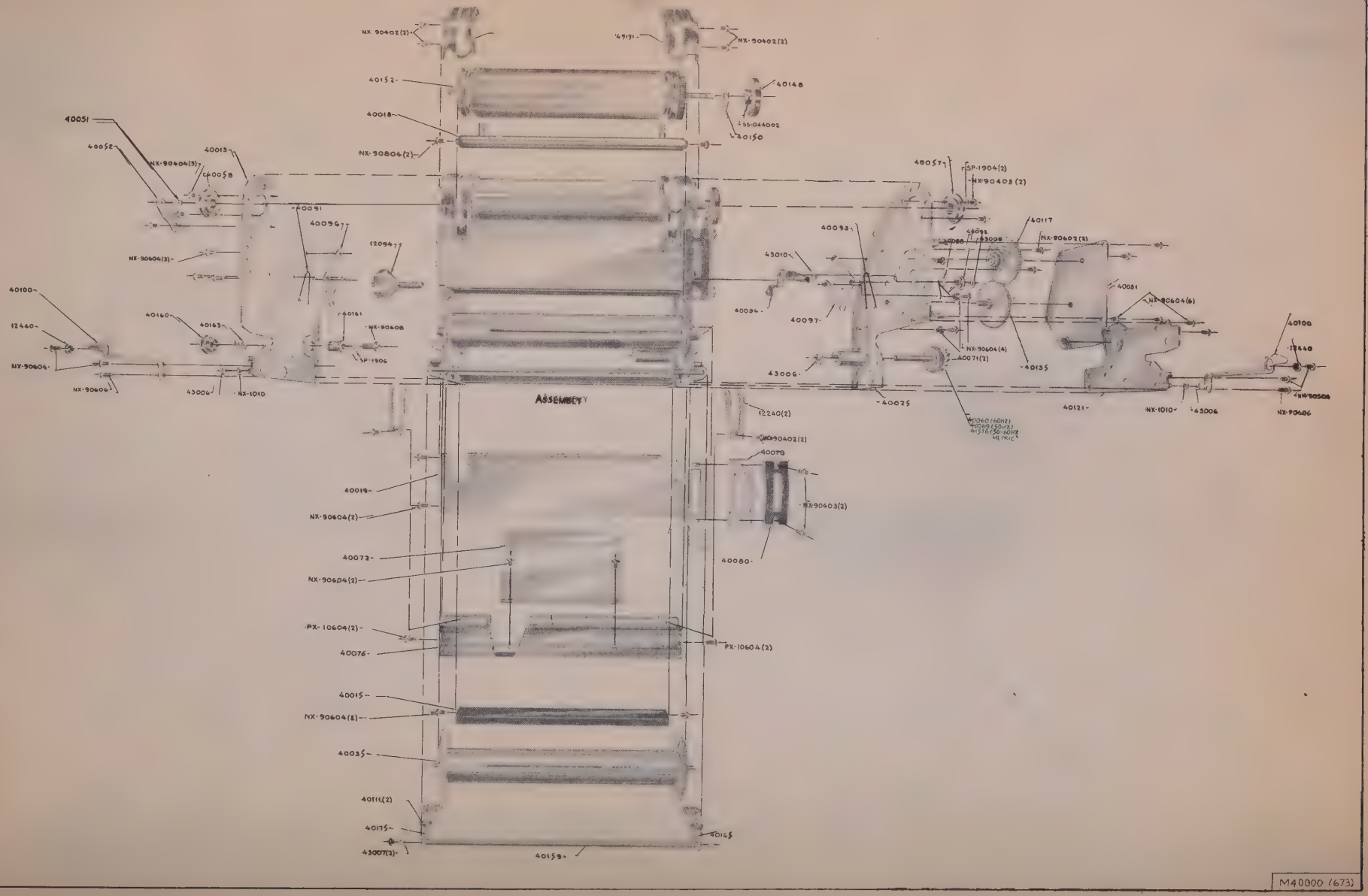
CHART DRIVE		REPLACEMENT PARTS		
BASE SPEED	POWER FREQ.	TRANS.* SPROCET	LADDER CHAIN	AUXILIARY METRIC GEARING
.75 IN.	60 Hz†	40346	43055-88	NONE
.75 IN.	50 Hz.	40346	43055-87	NONE
.5 IN.	60 Hz†	41309	43055-86	NONE
.5 IN.	50 Hz.	41309	43055-85	NONE
METRIC	60 Hz†	40109	43055-89	41500
METRIC	50 Hz.	40346	43055-90	41500
OPTIONAL** (40555)	50 Hz. AND 60 Hz.	40109(50) 40346(60)	43055-87	41500(A/R)

* PART OF MOTOR/TRANS. ASSEMBLY.
† ALSO APPLICABLE TO 50 Hz. FOR HOUR FEEDS ONLY.
** ALSO REQUIRES: IDLER (40554), SPACER (40555), SETSCREW (SS063202), AND ALLEN WRENCH (43111).

REF: 42500-1, -2 (6/73)

M42500-2

FIGURE D15. PARTS DIAGRAM FOR PANELGRAPH CHART DRIVE SYSTEM.



M40000 (673)

FIGURE D16. PARTS DIAGRAM FOR PANELGRAPH CHART TRANSPORT.

Sales Offices in Other Countries

ARGENTINA

Buenos Aires

D. F. Olivella
Florida 253
Buenos Aires, Argentina
Manager:
Freight To: Same

AUSTRALIA

South Melbourne

Electrical Equipment of Australia, Ltd.
2 Palmer Street (Victorian Branch)
South Melbourne, Australia
Manager:
Freight To: Same

Sydney

Electrical Equipment of Australia, Ltd.
Box 4619, G.P.O.
Sydney, N.S.W., Australia 2001
Phone: 618321
Manager: P. T. Wright
Freight To: 86 Liverpool Street Sydney, N.S.W., 2000

BELGIUM

Brussels

C. N. Rood, S.A.
Place de Jamblene de Meux 37
B-1040 Brussels, Belgium
Phone: 02 35 21 35
Manager: Francoise Kelem
Freight To: Same

BRAZIL

Rio de Janeiro

Staub S/A
P. O. Box 9013
Botafogo
20.000 Rio de Janeiro - GB - Brazil
Phone: 226-2043
Manager:
Freight To: Rua Martins Ferreira, 75

Sao Paulo

Staub S/A Electronica Comercia E Ind.
Caixa Postal 30-318
Sao Paulo 01000, Brazil
Phone: 247-0114
Manager: Emile Staub
Freight To: Same

CANADA

Calgary

Showalter Agencies Ltd.
2510 Fourth Street S.W.
Calgary Alberta, T2S 1X6 Canada
(403) 269-6411
Manager: R. G. Lawrence
Freight To: Same

Montreal Area

Instro-Test Ltd.
1024 Notre Dame St.
Lachine, H8S 2C2 Quebec, Canada
(514) 637-1231
Manager: William Hobson
Freight To: Same

Toronto Area

Ahearn & Soper Ltd.
31 Enterprise Road
Rexdale, Ontario M9W 1C4, Canada
(416) 247-7141
Manager: Joe Paul
Freight To: Same

Vancouver Area

Ahearn & Soper Ltd.
1680 Gilmore Avenue
Burnaby 2, B.C., Canada
(604) 291-0214
Manager: Al Cornish
Freight To: Same

DENMARK

Copenhagen

Tage Olsen A/S
Teglvaerksgade 37
DK-2100 Copenhagen, Denmark
Phone: (01) 294800
Manager: Henning Hansen
Freight To: Same

ENGLAND

London

International Instruments Ltd.
31, Cross Lances Road
Hounslow, Middiesex, England
Phone: (01) 572-3331
Manager: Mike Moy
Freight To: International Instruments, Ltd.
31, Cross Lances Road
Hounslow, Middlesex, England
c/o Baxter Hoare—44/1-49/1
Building 521 Stanstead Road
Heathrow Airport
London, Hounslow, England

FINLAND

Helsinki

Havulinna Oy. (V)
Vuroikatu 16
00100 Helsinki, Finland
Phone: (90) 661-451
Manager: Pekka Viitanen
Freight To: Same

FRANCE

Paris Area

INDELCO
Cie Industrielle de Mesures Elec.
115 Quai du Pecq
78 SARTROUVILLE, France
Phone: 270.90.90 or 737.34.87
Manager: Christian Gilbert
Freight To: Same

GERMANY

Munich

Neumuller & Co. GMBH
8 Munchen 2
Karlstrasse 55, West Germany
Phone: 592421
Manager: Carl Baasel
Freight To: Same

HOLLAND

Amsterdam

Hitma B.V.
Jan Luykenstraat 3
Amsterdam—Z, Holland
Phone: 76.48.75
Manager: J. A. Schepers
Freight To: Same

INDIA

Bombay

Motwane Private Limited
P. O. Box 1312
Bombay 1, India
Phone: 252337
Manager: Girdhar N. Motwane
Freight To: 127 Mahatma Gandhi Road, Bombay 1, BR, India

IRAN

Tehran

Tektron Co., Ltd.
Mahnaz Square—Abbasabada Ave
P. O. Box 14/1517
Tehran, Iran
Manager: K. Nakshineh
Freight To: Same

ISRAEL

Tel-Aviv

STG International Ltd.
P. O. Box 1276
Tel-Aviv, Israel
Phone: 53459
Manager: T. Gruber
Freight To: 52 Nachiat Benyamin St. Tel-Aviv, Israel

ITALY

Milan

Ing. S. & Dr. Guido Belotti
Piazza Trento 8
20135 Milano, Italy
Phone: 54.20.51
Manager: Dr. Guido Belotti
Freight To: Same

JAPAN

Tokyo

Shoshin Shoji Kaisha, Ltd.
P. O. Box Nihonbashi 173
Tokyo, Japan
Phone: 03-270-5921
Manager: Hiro Takano
Freight To: Nissho Bldgs. Muromachi, Nihonbashi, Tokyo, Japan

MALAYSIA & INDONESIA

Singapore

Mechanical & Combustion Engineering Co. Pte. Ltd.
10-12, Jalan Kilang
Singapore 3
Phone: 647151
Manager: Y. F. Zee
Freight To: Same

Selangor

Mecomb Malaysia Sdn. Bhd.
P. O. Box No. 24
Petaling Jaya
Selangor
Federation of Malaysia
Manager:
Freight To: Same

MEXICO

Mexico City

Sociedad Electro-Mecanica, S.A.
Apartado Postal 42-164
Mexico 4, D.F.
Phone: 5-66-36-00
Manager: Carlos Lira Ch.
Freight To: Manual Maria Contreras 25
Mexico 4, D.F.

NEW ZEALAND

Christchurch

E. C. Gough, Ltd.
P. O. Box 22873, High Street
Christchurch 1, New Zealand
Phone: 62 254
Manager: George S. Errington
Freight To: 245 St. Asaph Street Christchurch 1, New Zealand

NORWAY

Oslo

Gustav A. Ring System Maskiner A/S
P. O. Box 5370 MJ
Oslo 3, Norway
Phone: 46-68-90
Manager: Ragnar Otterstad
Freight To: Sorkedalsvn 33 Oslo 3, Norway

PAKISTAN

Karachi

United Traders
Haroon Chambers
Altaf Husain Road
Karachi, Pakistan
Manager: F. H. Ansari
Freight To: Same

PERU

Lima

Importaciones Y Representaciones Electronicas S.A.
Avoa. Franklin D. Roosevelt 105
Lima 1, Peru
Phone: 27-2076
Manager: F. Bonifaz Mattza
Freight To: Same

REPUBLIC OF CHINA

Taiwan

Industrial Electronics
P. O. Box 22423
89-2 Lane 75
Nanking East Road, Section 4
Taipei, Taiwan
Republic of China
Phone: 774257
Manager: H. T. Liu
Freight To: Same

SOUTH AFRICA

Cape Town

K. Baker Associates (Pty.) Ltd.
P. O. Box 3641
Cape Town 8000, South Africa
Phone: 43-7769
Manager: Keith MacKenzie
Freight To: Johannesburg

Durban Area

K. Baker Associates (Pty.) Ltd.
P. O. Box 568
Pinetown, Natal 3600
South Africa
Phone: 72-2689
Manager: Abe J. Barnard
Freight To: Johannesburg

Johannesburg

K. Baker Associates (Pty.) Ltd.
P. O. Box 1257
Johannesburg, 2000 Transvaal
South Africa
Phone: 42-1939/2043/2483
Manager: J. G. Barnard
Freight To: K. Baker Associates (Pty.) Ltd.
3rd Floor, Hyde Park Corner
Jan Smuts Avenue
Sandton, Transvaal
South Africa

SPAIN

Madrid

Auxitrol Iberico S.A.
C/. Caucho, s/n
Poligono Industrial
Torrejon de Ardoz
Apartado 36.233
Madrid, Spain
Phone: 675 23 50 - 54
Manager: A. Bueno
Freight To: Same

SWEDEN

Stockholm Area

Bergman & Beving AB
Karlavagen 76
Stockholm 10, Sweden
Phone: 08/246040
Manager: Rolf Wyren
Freight To: Same

SWITZERLAND

Zurich

Seyffer & Company
A. G. Instruments Division
Hohlstrasse 550
8048 Zurich, Switzerland
Phone: 01 62 82 00
Manager: Kurt Lindenmann
Freight To: Same

THAILAND

Bangkok

The International Engineering Co., Ltd.
Electrical & Communication Dept.
P. O. Box 39
Bangkok, Thailand
Manager: Prayong Ansusinha
Freight To: 614 Sukhumvit Road

TURKEY

Ankara

ODET
Mesrutiyet Cad
41/9 Kizilay
Ankara, Turkey
Phone: 17 07 92
Manager: Erdogan Gultekin
Freight To: Same

VENEZUELA

Caracas

Instrulab C.A.
Edificio Luro, Local LR2
Paseo Los Illustres, Las, Acacias
Caracas 104, Venezuela
Phone: 61 41 38 and 61 45 58
Manager: Ing. Guillermo Sanchez V.
Freight To: Rex Air Freight, Inc. Building 2142 — Miami International Airport — Miami, Florida
Mark: Consigned to Fernandez & Cia., Attn: Mr. Carlos Equi
Caracas 104, Venezuela
Notify: Instrulab C.A.

Sales Offices in the United States

ALABAMA

Birmingham

Spader & Associates
P. O. Box 6074
Birmingham, Alabama 35209
(205) 879-1366
Manager: James Spader
Freight To: 2805 Crescent Ave., Suite P, Zip 35209

ARIZONA

Phoenix Area

BFA Corp Of Arizona
4251 North Brown Ave., Suite #7
Scottsdale, Arizona 85251
(602) 946-4215
Manager: George Aeed
Freight To: Same

ARKANSAS

Little Rock

Electra-Tech Midsouth, Inc.
P. O. Box 9269
Little Rock, Arkansas 72209
(501) 562-4090
Manager: Joe Rolf
Freight To: 10324 Independence Zip: 72209

CALIFORNIA

Los Angeles Area

Esterline Angus (Branch Office)
137 N. Puente Avenue
City of Industry, California 91746
(213) 330-1621
Manager: Herman Knapp
Freight To: Same

San Francisco Area

Esterline Angus (Branch Office)
P. O. Box 4777
Hayward, Ca. 94540
(415) 785-8232
Manager: Don Feiler
Freight To: 225 W. Winton Ave., Suite 119, Hayward, Ca. 94544

COLORADO

Denver

The Cliff Beabout Co.
666 Sherman St.
Denver, Colorado 80203
(303) 831-7259
Manager: Clifford Beabout
Freight To: Same

FLORIDA

Orlando

Datarep, Inc.
P. O. Box 5929
Orlando, Florida 32805
(305) 843-5224
Manager: Warren Diehl
Freight To: 3450 Rio Vista Zip: 32805

Pompano Beach

Datarep, Inc.
P. O. Box 5277
Pompano Beach, Florida 33064
(305) 781-9279
Manager: Harold Quast
Freight To: 230 N. W. 40th St. Zip: 33064

St. Petersburg

Datarep, Inc.
5211 Fifth Ave., South
St. Petersburg, Florida 33707
(813) 345-8503
Manager: Dave Ross
Freight To: Same

GEORGIA

Atlanta Area

Spader & Associates
P. O. Drawer 1858
Decatur, Ga. 30031
(404) 296-3024
Manager: Lou Bandy
Freight To: Office H
10 North Clarendon Road
Avondale Estates, Ga. 30002

HAWAII

Berkley Engineering & Equipment Co., Inc.
P. O. Box 3856
Honolulu, Hawaii 96812
(808) 538-1921
Manager: Peter U. Hansen
Freight To: 564 South Street
Honolulu, Hawaii 96812

ILLINOIS

Chicago Area

Esterline Angus (Branch Office)
188 Industrial Drive, Suite 22
Elmhurst, Illinois 60126
(312) 833-4410
Manager: William H. Wirth
Freight To: Same

INDIANA

Indianapolis

C. D. Arnold Co.
P. O. Box 50230
Indianapolis, Indiana 46250
(317) 546-4053
Manager: Cal Arnold
Freight To: 4180 Elmhurst Dr. Zip: 46226

IOWA

Cedar Rapids

Harry E. Ferris Co.
500 35th Street, S.E.
Cedar Rapids, Iowa 52403
(319) 362-9156
Manager: James E. Ferris
Freight To: Same

Des Moines

Harry E. Ferris Co.
4005 Plainview Dr.
Des Moines, Iowa 50311
(515) 255-5008
Manager: Harry E. Ferris
Freight To: Same

LOUISIANA

New Orleans

Mid-South Sales Co.
P. O. Box 13625
New Orleans, La. 70185
(504) 822-3030
Manager: William Barnes
Freight To: 7979 Earhart Blvd. Zip: 70125

MASSACHUSETTS

Boston Area

Esterline Angus (Branch Office)
P. O. Box 385
Holliston, Massachusetts 01746
(617) 235-5343, 429-1551
Manager: Bill Calbert
Freight To: 21 Charles St. Zip: 01746

MICHIGAN

Detroit Area

George R. Peters Associates
P. O. Box 1158
Berkley, Michigan 48072
(313) 564-6325
Manager: George R. Peters
Freight To: 3347 Coolidge Hy. Zip: 48072

Marquette

NWR Electronics Corporation
P. O. Box 310
Marquette, Michigan 49855
(906) 228-9660
Manager: William Jackson
Freight To: U.S. 41 West
Negaunee Township
Zip: 49855

MINNESOTA

Minneapolis

Electrical Jobbers Equipment, Inc., 2533 - 24th Ave. S.
Minneapolis, Minnesota 55406
(612) 721-4815
Manager: Charles F. Healy
Freight To: Same

Virginia

NWR Electronics Corporation
P. O. Box 118, Hoover Road
Industrial Park,
Virginia, Minnesota 55792
(218) 741-5080
Manager: Kenneth Mannikko
Freight To: 107 South 15th Ave. Zip: 55792

MISSOURI

Kansas City

C. B. Fall Co.
9625 Shepherds Drive
Kansas City, Missouri 64131
(816) 942-3912
Manager: Carlton T. Lewis
Freight To: Same

St. Louis Area

C. B. Fall Co.
9291 Watson Rd.
Crestwood, Missouri 63126
(314) 968-3850
Manager: Carl G. Lewis
Freight To: Same

NEW MEXICO

Albuquerque

BFA Corp. of Arizona
9004 Menaul NE
Albuquerque, New Mexico 87112
(505) 292-1212
Manager: Jerry Beckes
Freight To: Same

Las Cruces

BFA Corp. of Arizona
P. O. Box 1237
Las Cruces, New Mexico 88001
(505) 523-0601
Manager: Dick Leger
Freight To: Dona Ana Road Zip: 88001

NEW YORK

Buffalo

The Robert F. Lamb Co., Inc.
1865 Kenmore Ave.
Buffalo, New York 14217
(716) 874-4900
Manager: Marion Lach
Freight To: Same

Kingston Area

The Robert F. Lamb Co., Inc.
P. O. Box 306
New Paltz, New York 12561
(914) 255-0800
Manager: Francis Stone
Freight To: 83 DuBois Rd. Zip: 12561

New York City Area

Esterline Angus (Branch Office)
34-23 Wisse Street
Lodi, New Jersey 07644
(201) 471-0084
Manager: Joe Zoppa
Freight To: Same

Rochester

The Robert F. Lamb Co., Inc.
4515 Culver Road
Rochester, New York 14622
(716) 544-5580
Manager: Clayton Van Buren
Freight To: Same

Syracuse

The Robert F. Lamb Co., Inc.
P. O. Box 28
Syracuse, New York 13211
(315) 454-2469
Manager: William Lawrow
Freight To: Pickard Bldg.
5858 East Molloy Rd.
Zip: 13211

NORTH CAROLINA

Charlotte

Ranson, Wallace & Baesel, Inc.
P. O. Box 6153
Charlotte, North Carolina 28207
(704) 334-4244
Manager: Grier Wallace
Freight To: 1815 Park Dr. Zip: 28204

OHIO

Cincinnati

The Beedle Equipment Co,
P. O. Box 36061
Cincinnati, Ohio 45236
(513) 793-0140
Manager: Edward (Ted) Annett, Jr.
Freight To: 7337 Montgomery Rd. Zip: 45236

Cleveland

M. A. Blankenburg & Co., Inc.
P. O. Box 81306
Cleveland, Ohio 44181
(216) 251-7010
Manager: Myron Blankenburg
Freight To: 4367 Rocky River Dr. Zip: 44135

OKLAHOMA

Oklahoma City

Kennedy Engineering Co.
P. O. Box 60781
Oklahoma City, Oklahoma 73106
(405) 524-6048
Manager: W. A. (Bud) Ihbe
Freight To: (Truck and Rail Express) 1818 N. W. 29th Street, Oklahoma City, Oklahoma 73106
Mark: Hold at Oklahoma City Dock and notify (405) 524-6048 for pick-up.

Tulsa

Kennedy Engineering Co.
6334 East 13th St.
Tulsa, Oklahoma 74112
(918) 835-9975
Manager: William Kennedy
Freight To: Same

OREGON

Portland

McLaren, Inc.
5319 S.W. Westgate Drive
Portland, Oregon 97221
(503) 297-2248
Manager: Stuart Smith
Freight To: Same

PENNSYLVANIA

Philadelphia Area

Esterline Angus (Branch Office)
Penn Plaza 2
120 Pennsylvania Ave.
Oreland, Pa. 19075
(215) 887-2268, 924-6300
Manager: John M. Caylor
Freight To: Same

Pittsburgh

Bollinger & Richards
P. O. Box 8088
Pittsburgh, Pa. 15216
(412) 561-2340
Manager: Walt Bollinger
Freight To: 169 Mayfair Dr. Zip: 15216

PUERTO RICO & VIRGIN ISLANDS

San Juan

Industrial Automation
G.P.O. Box 2132
San Juan, Puerto Rico 00936
(809) 789-2900
Manager: Bill Babil
Freight To: 53 Esmeralda Ave., Guaynabo, Puerto Rico 00657

TENNESSEE

Knoxville

George W. Massey Co.
P. O. Box 10905
Knoxville, Tennessee 37919
(615) 577-9553
Manager: George Massey
Freight To: 4040 Maloney Rd. Zip: 37920

TEXAS

Borger

Kennedy Engineering Co.
P. O. Box 3434
Borger, Texas 79007
(806) 273-2871
Manager: Robert I. Hibbs
Freight To: 116 Phillips Rd. Zip: 79007

Dallas

Data Aids Associates
11393-B Harry Hines Blvd.
Dallas, Texas 75229
(214) 620-1551
Manager: Robert Gough
Freight To: Same

Houston

Data Aids Associates
1440 N. Loop
Houston, Texas 77009
(713) 862-6685
Manager: Dwain Countryman
Freight To: Same

UTAH

Salt Lake City

Instrumentation Sales
1777 E. Meadow Downs Way
Salt Lake City, Utah 84121
(801) 272-3793
Manager: Ray Moore
Freight To: Same

WASHINGTON

Seattle Area

McLaren, Inc.
P. O. Box 2029
Bellevue, Wash. 98009
(206) 454-3400
Manager: Gordon McLaren
Freight To: 1628 130th N.E. Bellevue, Wash. 98005

WASHINGTON, D.C.

Hildenbrand Company, Inc.
P. O. Box 1060
Fairfax, Virginia 22030
(703) 280-2330
Manager: Harold Hildenbrand
Freight To: (Truck and Rail Express) 7899 Heritage Drive, Heritage Mall, Annandale, Virginia 22003. (Air Express) National Airport Marked: Notify Hildenbrand Co., Inc., for pick-up 280-2330

WEST VIRGINIA

Charleston

Vynock Engineering Co.
P. O. Box 363
Charleston, West Virginia 25322
(304) 722-3525
Manager: Richard Wynock
Freight To: Rt. 1, Box 626 Vorpes Valley View St. Albans, W. Va. 25177

WISCONSIN

Milwaukee

T. R. Bickler Associates
P. O. Box 7245
Milwaukee, Wisconsin 53213
(414) 453-3772
Manager: Tom Bickler
Freight To: 11760 W. Center St., Wauwatosa, Wisconsin 53222

INSTRUMENT DATA SHEET - CUSTOMIZED SPECIFICATIONS

MODEL S 600 T EVENT RECORDER WITH TEMPEN CHANNELS TWENTY

WESTERN ELECTRIC CO. LOS ANGELES, CALIF.

No. 51-6-0285T-2A1 S.O. No. M83200 Date 1/24/[illegible]

PACIFIC TELEPHONE EMERYVILLE, CALIF.

CASE-ABGRAPH CRMH Lamp

Drive Features

RECORDING CIRCUIT: Model B-1T-21 Rating 120V.-60CPS

1 THRU 20 CHANNELS Sc. No. 45263-2 CHART No. 37020-C

ELECTROMAGNET ASSEMBLIES 20-RT N.P. Nos. 43094, 43011, 43014

VOLTAGE TYPE - SEPARATE CIRCUITS

Coil Numbers 1 THRU 20	Rating 24 V.-DC	Av. Coil Resistance 165Ω	Series Res.	
Coil Numbers	Rating	Av. Coil Resistance	Series Res.	
Coil Numbers	Rating	Av. Coil Resistance	Series Res.	
Coil Numbers	Rating	Av. Coil Resistance	Series Res.	

No. Volts Mat. N.P. No.

No. Volts Mat. N.P. No.

TERMINAL CODE PLATE (CONNECTIONS)

	RATING	CHANNEL	RATING
1 Fuse Input - NEUTRAL	120V.-60CPS	1 THRU 20	- V.-DC
2 Fuse Input - LINE	120V.-60CPS		

SEE TERMINAL CODE PLATE ON RECORDER FOR ELECTROMAGNET CONNECTIONS

45334-2 CONNECTION DIAGRAMS 43094 ON REAR OF CASE, 45334-2

SPECIAL FEATURES:

CHART DRIVE: CATALOG No. 227 - HOUR - MINUTE - SECOND - SPEEDS

Speeds per Hr. 3/4-1 1/2-3-6-12 Speeds per Hr. 3/4-1 1/2-3-6

Gear Train No. 45120 Synchronous Motor No. 44200-16 Motor No. 40475-2 Volts 120 CPS 60

Coil No. Volts C.P.S. Ohms Series Ohms

Type Motor No. 40497 Part No. 2C498 Volts 120 C.P.S. 60

Chart Drive Features FURNISH ONE No. 45068 POWER LEAD

ELECTRIC TESTS - (Terminals to Case): Coil Circuits 1500 Thermal Circuit

Power Supply Hr. / Min. Feed Motor 600

Hr. Feed Motor 600 Lamp Circuits Trip Coil

AUXILIARY APPARATUS

Speed Trans.	Mfr.	Mode	Volts Pri.	Sec.	C.P.S.	
Counter	Mfr.	Model	Mfg.	Volts	C.P.S.	
Switch	Mfr.	Mode	Mfg.			

11-3-70

Wiring DC Meter Card Entry Calib. by Date 11-4-70

Order No. SM 45270-2 Final

SERIAL No. 203679

Mention this number in correspondence

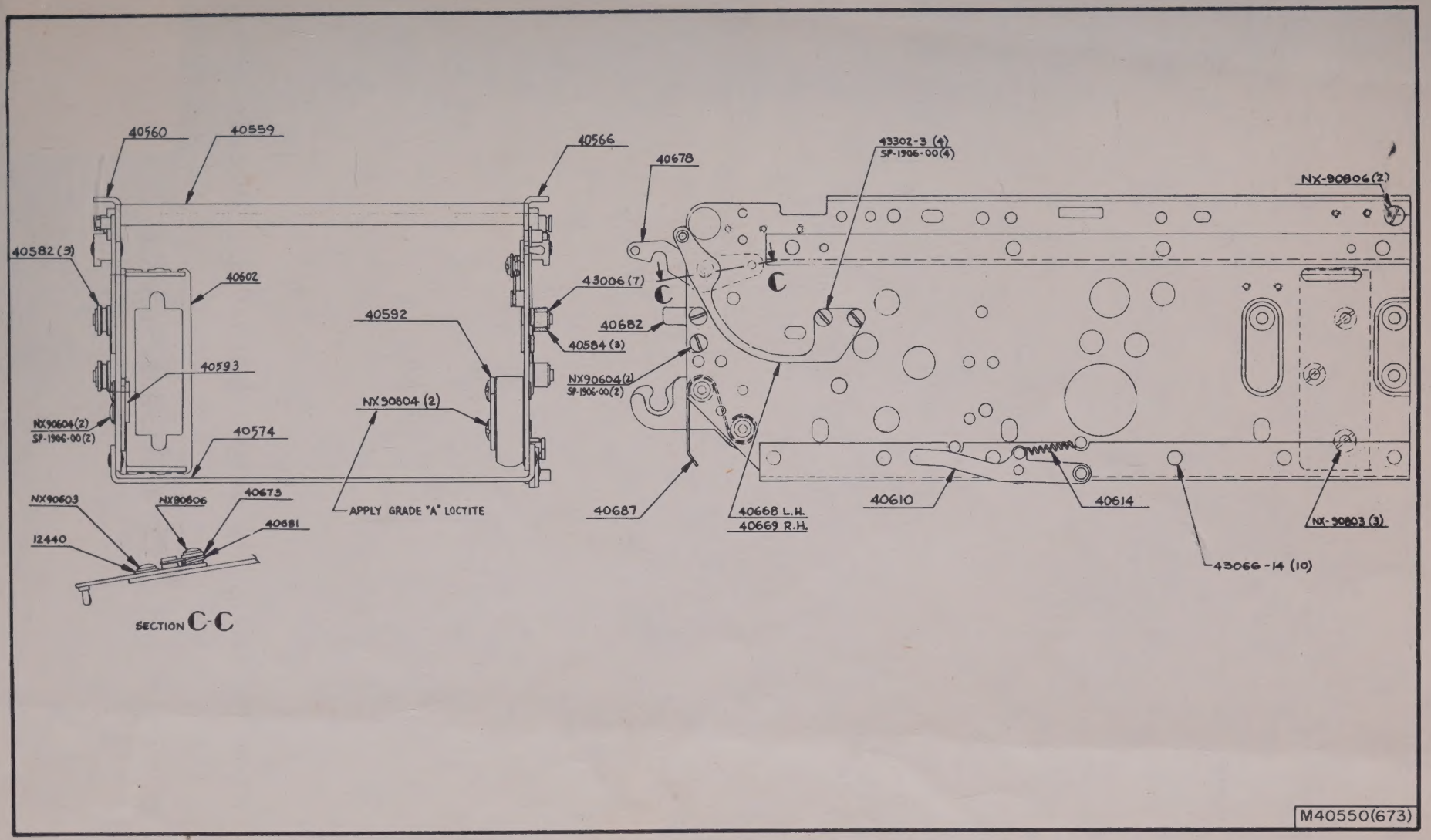
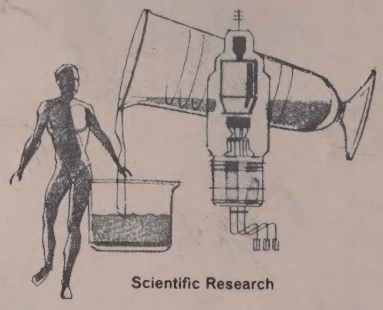


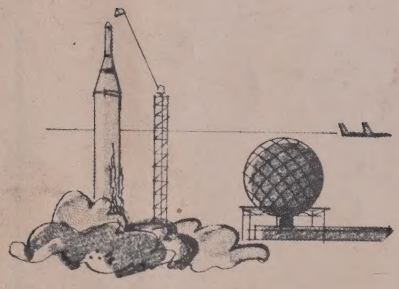
FIGURE D17. PARTS DIAGRAM FOR PANELGRAPH CHASSIS SUBASSEMBLY.

Esterline Angus manufactures one of the most complete lines of scientific and industrial recording instruments in the world. Over the past 70 years, Esterline Angus has expanded its instrumentation to include:

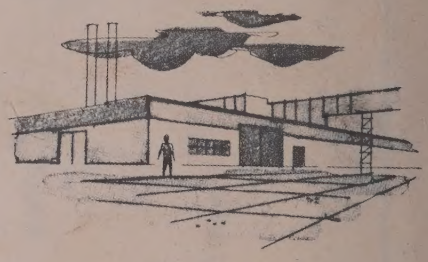
GRAPHIC RECORDERS	• Galvanometric • SPEEDServo ® • Potentiometric	• Electrodynamometer • Multipoint • Oscillographic	• Event Recorders • X-Y Recorders • Minigraph	• Pressure Recorders • Vacuum Recorders • Customized Units
TRANSDUCER DEVICES	• Signal-Conditioning Amplifiers • Potential Transformers • Rotation-to-Pulse Transducers	• Attenuators • Integrators • Multipliers	• Industrial Tach Generators • Current Transformers • Calibrated Shunts	
OTHER INSTRUMENTS	• Programmable Data Acquisition Systems • Digital Multimeters	• Digital Printers • Voltage Standards • Chart Inspectors	• Electronic Alarms • Function Generators • Ultrasonic Cleaners	



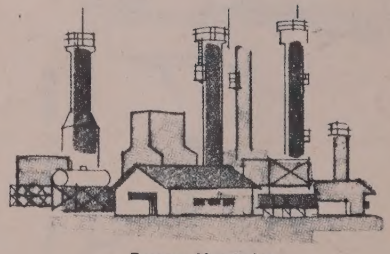
Scientific Research



Space Exploration



Production Analysis



Process Monitoring

ESTERLINE ANGUS, BOX 24000, INDIANAPOLIS, INDIANA 46224

ESTERLINE ANGUS

A UNIT OF ESTERLINE CORPORATION

S620XT
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